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AUGUST 27, 1984

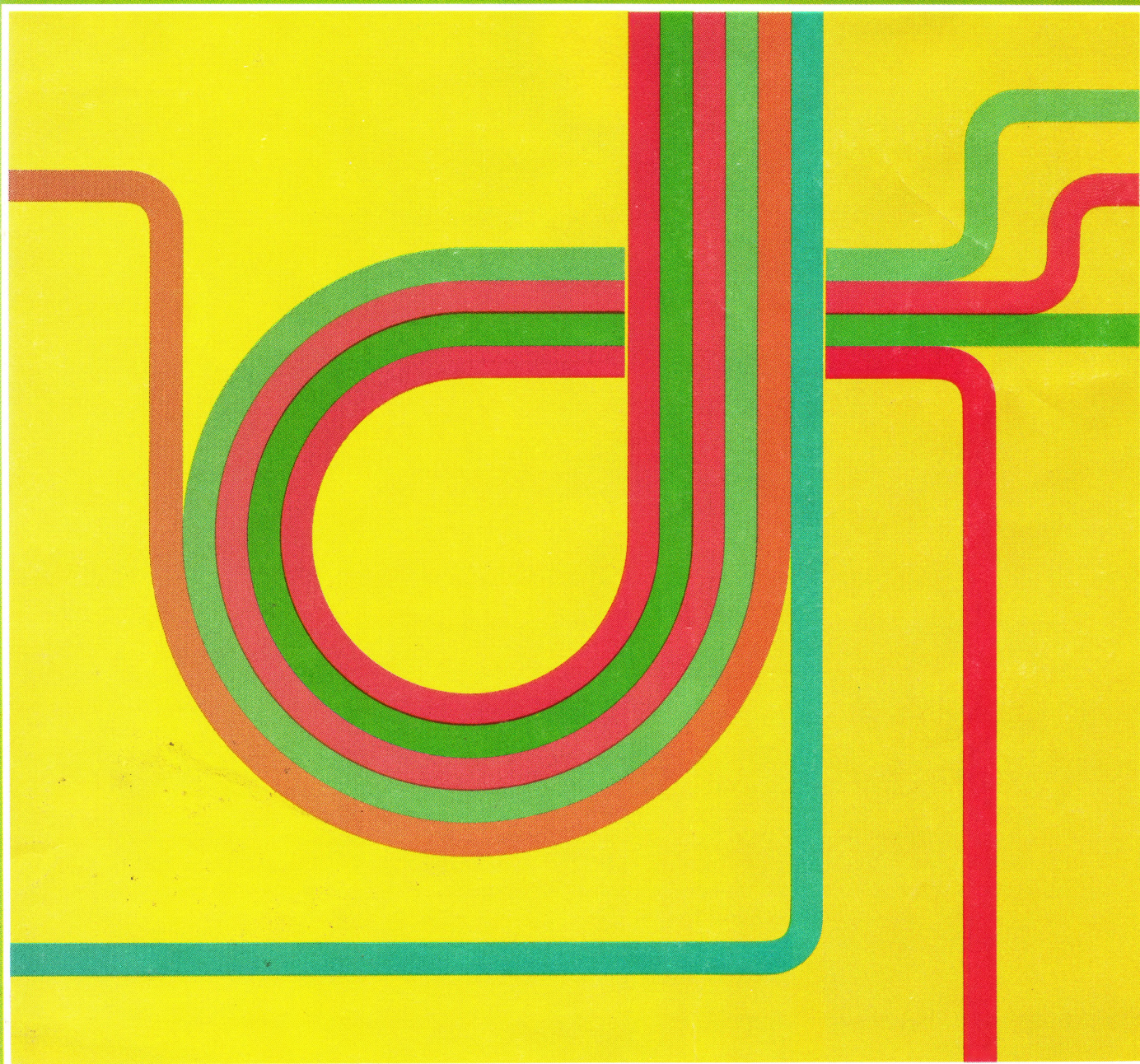
\$3

ElectronicsWeek®

RCA plans
new strategy
for CMOS

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Write-once laser disk to be introduced by Matsushita in fall/28

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Single instrument synthesizes two signals and cuts equipment needs/79



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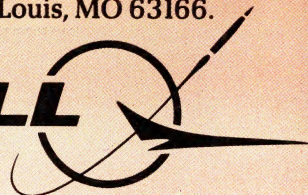
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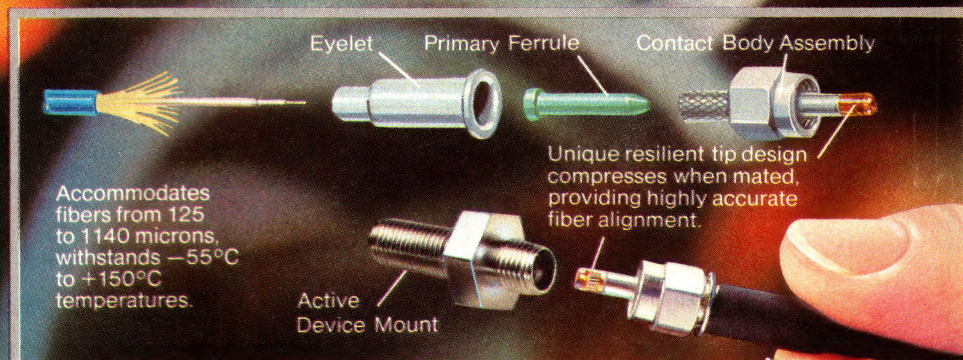
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Next ElectronicsWeek

Selecting robots for today's production and test lines

Robots are entering every phase of manufacturing and production. From assembly lines to testing chambers, they are taking over more and more dangerous and routine tasks, thus freeing people to concentrate on creative enterprises. Graeme Kinsey, of Zehntel Inc. in Walnut Creek, Calif., explains how best to select a robot for industrial use. Such factors as work envelope, repeatability, accuracy, programmability, and many more enter into the selection process. Read about it in next week's Special Reports section.

Application-specific ICs are not just a passing fancy

Is today's demand for application-specific integrated circuits—gate arrays, standard cells, and full custom—and the heavy attention being given this segment of the semiconductor industry just a passing fancy? Or is it the reaction to a shortage of standard parts that will fade as capacity grows to meet demand? Neither: the explosive growth in the custom and semicustom markets is testimony to major changes in the IC industry. Recent advances are driving a movement toward custom ICs that will not only force its continued growth but cause it to dominate and change IC technology. Keep up with the changes in next week's *ElectronicsWeek*.

Looking ahead in ElectronicsWeek

Software tool makers look forward to booming market

The need for more and better tools to support and automate the software life cycle has attracted both hardware manufacturers and independent vendors into a market whose growth should surpass that of the exploding software applications market, according to market observers. For a peek into the software industry's future, see contributing editor Stephen Evanczuk's article in an upcoming *ElectronicsWeek*.

August 27, 1984 Volume 57, Number 20
113,277 copies of this issue printed

ElectronicsWeek (ISSN 0748-3252). Published weekly by McGraw-Hill, Inc. Founder: James H. McGraw 1860-1948. Publication office: 1221 Avenue of the Americas, N.Y., N.Y. 10020; second class postage paid at New York, New York and additional mailing offices. Postage paid at Montreal, P.Q. Registration Number 9034.

Executive, editorial, circulation and advertising addresses: *ElectronicsWeek*, McGraw-Hill Building, 1221 Avenue of the Americas, New York, N.Y. 10020. Telephone (212) 512-2000. Teletype 12-7960 TWX 710-581-4879. Cable address: M C G R A W H I L L N E W Y O R K.

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CMOS is a Solid State of mind.



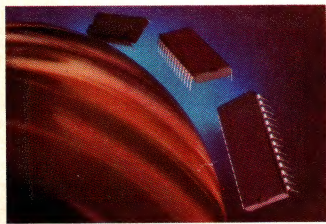
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Quick specs on the 23C128

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For details on our new 23C128 CMOS ROM or any of our other CMOS memories or logic devices, just call or write. And find out why CMOS is a Solid State of mind. Solid State Scientific, 3900 Welsh Rd., Willow Grove, PA 19090. (215) 657-8400.



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ElectronicsWeek

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FOR RCA

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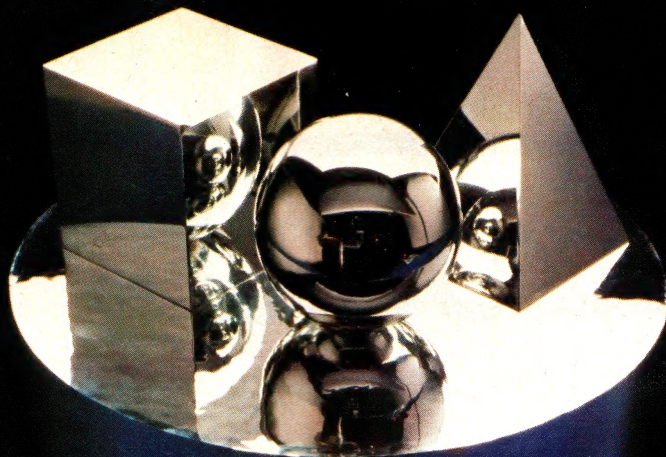
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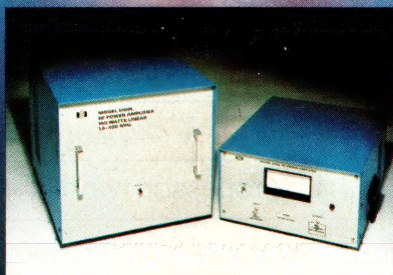
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Special Reports

Distribution Distributors poised to enter the fourth era. Thanks to a strong recovery in components, more systems business, and a risky but potentially profitable partnership with semiconductor makers, the distribution business never looked healthier **67**

Military Integrated Circuits Military ICs make up for lost ground. Digital signal processors and GaAs chips are heading the Defense Department's most-wanted list as the U.S. military semiconductor market is expected to grow to \$2.6 billion by 1988 **75**

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SIEMENS

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Your thyristors should turn off. So they need reactive power. Their short turn-off times ($15 \mu\text{s}$) lead to short circuit-commutating times ($28 \mu\text{s}$).

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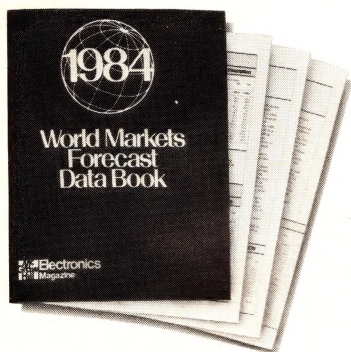
The fuse in all MKV capacitors prevents shorting and thus destruction of commutating thyristors.

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Market Profile



The 1984 World Markets Forecast Data Book is now available! The highly respected 26th annual market forecast has been updated and expanded to provide an analytical profile of the current and future demands of the electronics market. The 1984 edition covers 845 products in the categories of semiconductors, components, communications, data-processing, industrial consumer and test and measurement equipment.

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Meetings

The Future of Optical Memories, Videodisks, and Compact Disks to the Year 2000, Technology Opportunity Conference (P.O. Box 14817, San Francisco, Calif. 94114), Loew's Summit Hotel, New York City, Oct. 15-17.

West Coast Electronic Office Expo & Conference, Cartlidge & Associates (4030 Moorpark Ave., Suite 205, San Jose, Calif. 95117), San Jose Convention Center, San Jose, Oct. 16-17.

Circuit Expo 84, Worldwide Convention Management Co. (Mary Burns Sheridan, Worldwide Convention Management Co., P.O. Box 159, Libertyville, Ill. 60048), The Centrum, Worcester, Mass., Oct. 16-18.

International Symposium on Electromagnetic Compatibility, IEEE (EMC 84/Tokyo, c/o Prof. Takagi, Tohoku University, Department of Communications, Sendai, Japan), Hotel Pacific, Tokyo, Oct. 16-18.

Maecon/84, IEEE (Electronic Conventions Inc., 8110 Airport Blvd., Los Angeles, Calif. 90045), Cervantes Convention Center, St. Louis, Oct. 16-18.

Internecon—International Electronic Packaging and Production Equipment Conference and Exhibition (British Information Services, 845 Third Ave., New York, N.Y. 10022), Metropole Exhibition Centre and Brighton Centre, Brighton, UK, Oct. 16-18.

UnixExpo, National Expositions Co. (14 W. 40th St., New York, N.Y. 10018), Sheraton Centre Hotel, New York, Oct. 16-18.

Fifth Assembly Technology Expo, Assembly Technology Expo (Assembly Technology Expo, 2400 E. Devon Ave., Suite 205, Des Plaines, Ill.), O'Hare Expo Center, Rosemont, Ill., Oct. 16-18.

International Test Conference, IEEE (Peter N. Bronecke, Program Chairman, International Test Conference 1984, P.O. Box 413, Moorestown,

N.J.), Franklin Plaza Hotel, Philadelphia, Oct. 16-19.

Convergence 84—The Sixth International Congress On Transportation Electronics, Vehicular Technology Society, *et al.* (Bruce McCristal, General Motors Corp., 10-263 General Motors Bldg., Detroit, Mich. 48202), Hyatt Regency Hotel, Dearborn, Mich., Oct. 22-24.

International Symposium on Noise and Clutter Rejection in Radars and Imaging Sensors, IEEE *et al.* (Toshimitsu Musha, Department of Applied Electronics, Tokyo Institute of Technology, 4259, Nagatsuta, Midori-ku, Yokohama, 227, Japan), Sakakawa Hall, Tokyo, Oct. 22-24.

10th International Symposium for Testing and Failure Analysis, The International Society for Testing and Failure Analysis (ISTFA, P.O. Box 4110, Torrance, Calif. 90510), Los Angeles Airport Hilton Hotel, Los Angeles, Oct. 22-26.

10th International Conference on Industrial Electronics, The Society of Instrument and Control Engineers of Japan and IEEE (Patrick P. Fasang, Microelectronics Center, General Electric Co., P.O. Box 13049, Research Triangle Park, N.C. 27709), Keio Plaza Inter-Continental Hotel, Tokyo, Oct. 22-26.

GaAs IC Symposium, IEEE (R. Allen Murphy, Lincoln Laboratory, Massachusetts Institute of Technology, P.O. Box 73, Lexington, Mass. 02173), Copley Plaza, Boston, Oct. 23-25.

Semicon/Southwest 84, Semiconductor Equipment and Materials Institute (Susan Castillo, SEMI, 625 Ellis St., Suite 212, Mountain View, Calif. 94043), Market Hall, Dallas, Oct. 23-25.

Personal Computers in Business and Government, National Institute for Management Research (Dept. PR, NIMR Seminars, P.O. Box 3727, Santa Monica, Calif. 90403), Sheraton National Hotel, Washington, D.C., Oct. 24-26.

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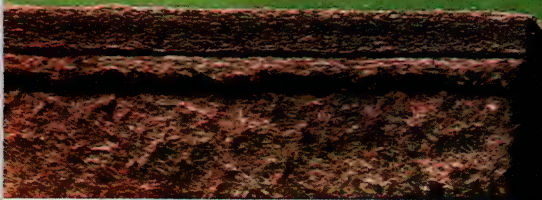
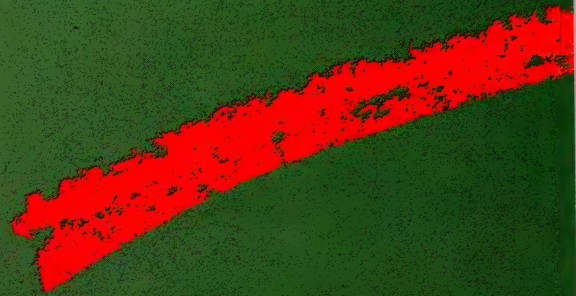


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NEC NEWSCOPE



NEC AND HONEYWELL BIND LONG-TERM COMPUTER TIES.

NEC and Honeywell Inc., have established a new 10-year business relationship in the computer field.

Under the new agreement Honeywell will market NEC's top-end mainframe, the NEC SYSTEM1000, with GCOS-8 operating system, in the U.S. as the upper machine of its very

large scale DPS-88.

The NEC SYSTEM1000 is an ultra-large general purpose computer designed for large-scale processing in on-line data base systems, engineering calculations and communications networks.

It has a 64MB main memory and 128 KB cache memory. The NEC

SYSTEM1000 incorporates high-speed logic LSIs, high-density MOS LSI memories and LSI high-density packages with up to 60 chips mounted directly on a multilayered substrate.

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NUMBER 131

ALL-SOLID-STATE 10kW VHF TV TRANSMITTER.

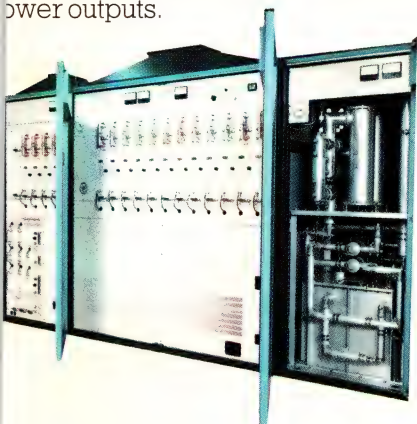
Today's most powerful all-solid-state VHF TV transmitter is available from NEC.

The 10kW transmitter incorporates diverse new technologies. Advances include high-efficiency high-power transistor amplifiers, low-loss RF combiners, high-efficiency switching regulators and a high-performance oscillator. It has 12 transistor power amplifier units working in parallel in the video section and 4 such units in the audio section. These feature greatly reduced component counts. A rubidium oscillator is used in conjunction with a synthesizer to assure ultra stable carrier frequencies.

Compared to tube types, the new all-solid-state transmitter offers many advantages including extra-high reliability, easy maintenance, unattended operation and complete safety.

The first unit was delivered a year ago and it continues to demonstrate satisfactory performance.

NEC also offers all-solid-state TV transmitters with 1kW, 3kW and 5kW power outputs.

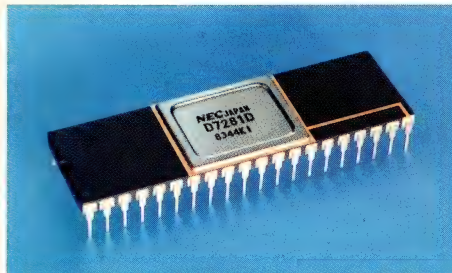


NON-VON NEUMANN IMAGE PIPELINED MICROPROCESSOR

Image processing demands repetitive high-speed operations on enormous amounts of data.

To perform this task with maximum efficiency, NEC has developed the μ PD7281D, the world's first non-Von Neumann type microprocessor with an amazing speed of 5 MIPS*. For processing an image of 640×400 pixels, it can rotate pictures or graphics freely to any angle at a speed of 1.4 seconds*.

By drastically reducing cost and size of image processing hardware, the new VLSI can add attractive features to CAD systems, facsimiles, copiers and other office automation equipment.



The μ PD7281D is also well suited for high-speed signal processing and numerical calculations—for products such as digital filters, robots and NC systems.

The new VLSI features ☐ Data-flow and flexible 5-block circular pipeline architecture. Different computations are independently 'data-driven' within the 5 blocks. ☐ Separate input and output buses. ☐ On-chip 16×16 bit multiplier. ☐ 200 ns* pipeline cycle for all operations. ☐ 32 PU instructions

including barrel shift, bit operation and bit check. ☐ Easy formation of multi-processor system for faster execution.

☐ Support LSI soon to be available to interface the μ PD7281D with host processor and memory. ☐ Easy software development with flow graph, functional assembler and simulator.

*Target figures.

WORLD'S LARGEST LOCAL DIGITAL EXCHANGES IN SYRIA.

The world's largest-scale local digital exchanges are now in service in the Syrian Arab Republic.

The two NEAX61 multiprocessor digital switching systems in Damascus, the capital, and Aleppo accommodate 40,000 subscriber lines each. At the same time, another 20,000-subscriber line NEAX61 system was also put into service in Damascus, a model city selected

by CCITT for telecommunications network digitalization.

Another feat achieved by NEC in the project was to carry out changeover from the existing systems (about 20,000 subscriber lines) overnight.

In addition to the switching systems, NEC has also delivered a total of 145 information service consoles and assistance service consoles.

NEC
NEC Corporation
Tokyo, Japan

TI creates IMPACT

These pace-setting devices from Texas Instruments operate at unprecedented clock speeds up to 50 MHz. They can cut processing time in half for such speed-critical applications as high-resolution graphics for CAD/CAM systems. New superminicomputers. Artificial intelligence machines. Wherever complex functions demand extremely large numbers of logic operations for rapid image access, use TI's new IMPACT bipolar PAL® ICs (TIBPAL-15 Series).

Propagation delay cut by 40%

TI's unique 2- μ m Implanted Advanced Composed Technology (IMPACT) dramatically reduces the size and the sidewall capacitance of circuit elements (see facing page). Establishes a new performance standard with propagation delay cut to 15 ns, maximum, at 180 mA—versus 25 ns at 180 mA for the fastest PAL ICs formerly available.

Space requirements cut by up to 83%

With their extremely dense circuitry, TIBPAL-15 Series devices can bridge the gap between SSI/MSI and LSI gate arrays. Now a single PAL IC can replace as many as six SSI or MSI circuits. And give you the flexibility of user-programmable logic in such fields as telecommunications and automotive control, where space constraints—as well as processing speed—are often critical.

Fast and easy programming

Programming TIBPAL-15 Series bipolar logic circuits, with their reliable titanium-tungsten fuses, takes only seconds using widely available software and inexpensive device programmers. And you can implement logic-design changes in minutes, without vendor retooling.

For any logic application where superspeed, high density, and immediate availability are design criteria, your best—and only—answer is a 15-ns PAL IC from Texas Instruments.

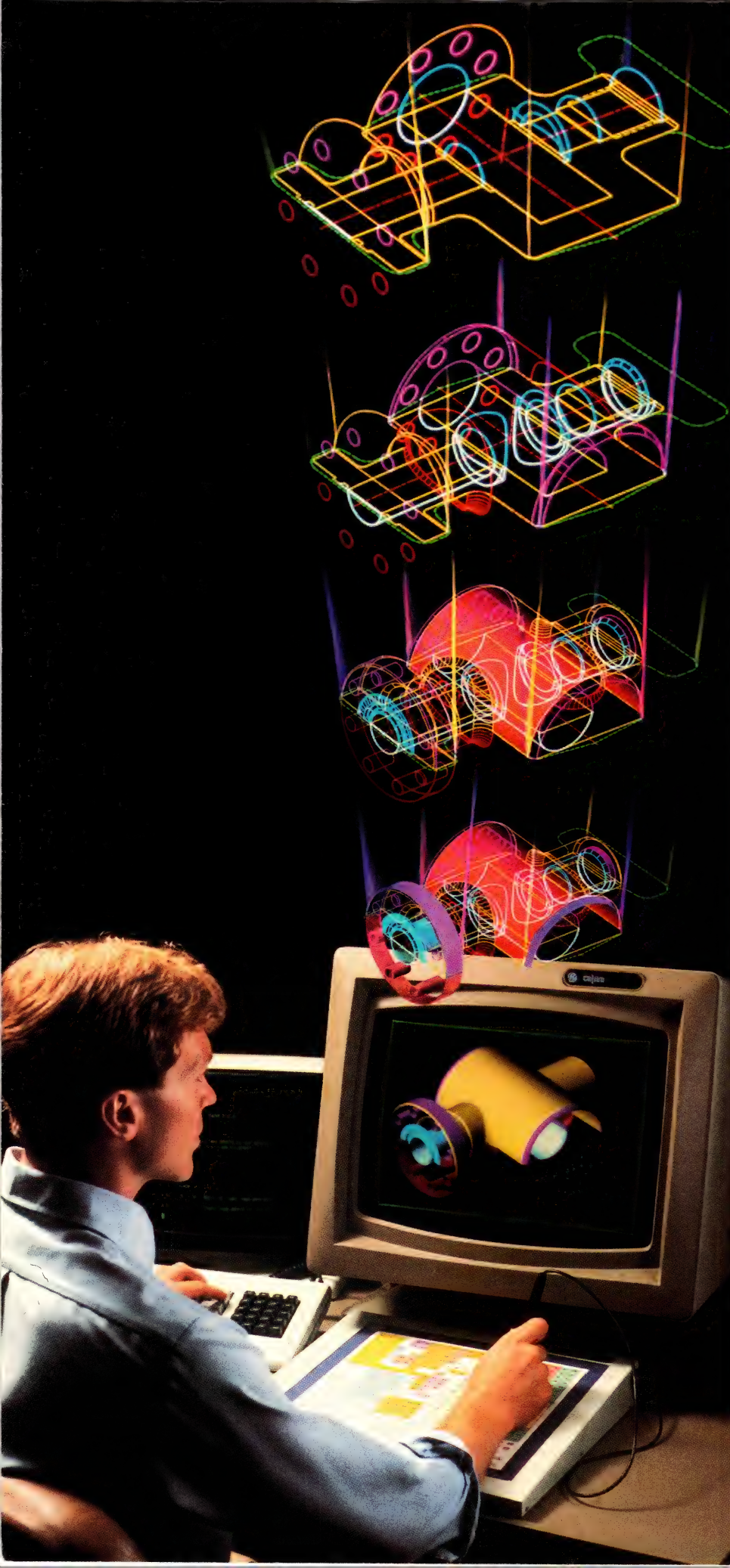
- ▶ **Processing 50 megabits of digitized data per second**, TI 15-ns PAL ICs will find widespread application in advanced, high-resolution graphics for CAD/CAM systems. These new superspeed PAL ICs can enhance performance by increasing both the speed and the size of the graphics-display processor.

Demonstration software courtesy of Calma Company.

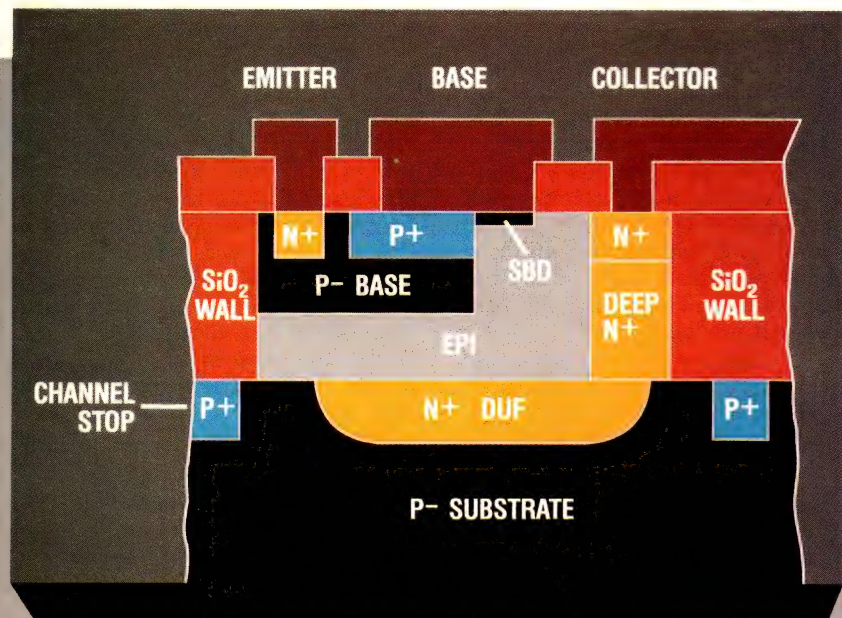
® PAL is a registered trademark of Monolithic Memories, Inc.

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the world's fastest PAL ICs: New process delivers 15-ns speed.



A highly significant reduction in capacitance results from the 2- μ m feature size which TI's IMPACT processing makes possible. Silicon dioxide is the isolation material. Switching speed is further enhanced by utilizing this silicon dioxide for emitter and base sidewalls.

Also from TI: The world's fastest FPLAs.

In addition to superspeed TIBPAL-15 Series ICs, Texas Instruments offers the industry's fastest Field Programmable Logic Arrays (FPLAs), with 20-ns maximum gate delay.

Whereas PAL ICs have a programmable AND array feeding a fixed OR array, the universal structure of the FPLA includes programmable AND and OR arrays. The FPLA provides the ultimate flexibility for implementing logic functions in the "complexity gap" between standard SSI/MSI and LSI/VLSI logic.

The wide range of programmable-logic devices available from Texas Instruments is described in the table below. In addition, military versions of the PAL16XXA/A-2 are available, with TIBPAL-15 Series and TIFPLA839/840 soon to come.

TI's Broad PAL/FPLA Family

	$t_{pd}(\max)$ (ns)	$I_{CC}(\max)$ (mA)	Registered Outputs
PAL ICs			
TIBPAL16L8-15	15	180	0
TIBPAL16R8-15	15	180	8
TIBPAL16R6-15	15	180	6
TIBPAL16R4-15	15	180	4
PAL16L8A/A-2	25/35	180/90	0
PAL16R8A/A-2	25/35	180/90	8
PAL16R6A/A-2	25/35	180/90	6
PAL16R4A/A-2	25/35	180/90	4
FPLAs			
TIFPLA839	20	190	0
TIFPLA840	25	190	0

For more information on Texas Instruments PAL ICs and FPLAs, call your local TI distributor. To receive a data-sheet collection on all the new TI high-performance, user-programmable products, call Texas Instruments Incorporated at 1-800-232-3200 Ext. 201.

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Circle 15 on reader service card

TI's new IMPACT technology boosts circuit density and performance levels.

IMPACT is a unique innovation of Texas Instruments, capitalizing on the advantages of composed-masking techniques to increase the speed and density of bipolar integrated circuits.

Composed masking yields high density

In composed masking, critical components are placed on the chip with a minimum number of masks. Thus they can be more tightly defined and more densely spaced than by conventional masking, which requires more precise registration.

The process also makes it possible to insulate critical base and emitter components with oxide walls. This insulation reduces sidewall capacitance, which at the dimensions of IMPACT features can represent as much as half the overall capacitance. Small size and oxide

walling together contribute significantly to the increase in switching speed.

Other important features of IMPACT technology are independently controlled base resistance and double-level metal with a 7- μ m pitch at the first level.

Exceptional reliability built in

The high speed, low power, and potential for large-scale integration that IMPACT makes feasible are valuable characteristics for chips used in harsh environments. Improved electrostatic-discharge (ESD) tolerance has been designed in. Copper-doped aluminum in the first-level interconnection eliminates electromigration during programming. Current densities, metal spacing, and contact sizes are all conservatively designed to add reliability to the process.

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A Closer Look. Diplomat helps you design your own semi-custom ICs. Typically, your logic board containing 30 or more discrete SSI/MSI ICs, can easily be compressed into a single integrated circuit. Diplomat can capture the design in 8 hours or less on Daisy GATEMASTER *real time* workstations, keeping costs to a minimum. Programs built into the Daisy workstation review the design, checking it for circuit errors and other faults.

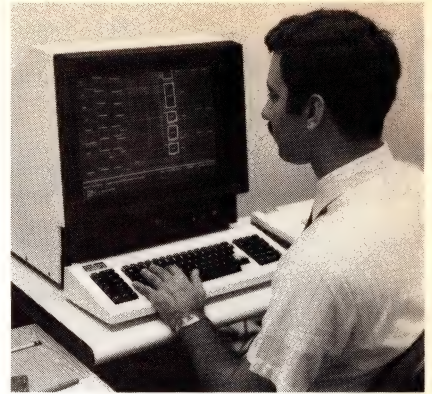
Daisy's DLS® simulation program using manufacturer's parametric data (i.e. Gate delay time, rise and fall time,

etc.) projects your circuits output waveform and performance specifications. Usually in as little as eight weeks or less, you will get your finished chips in prototype quantities, or as many as you want. Benefits are real: lower total system costs, improved performance, savings in power and size, lower field service costs, higher reliability and the security of having a design that can't be duplicated with off-the-shelf products.

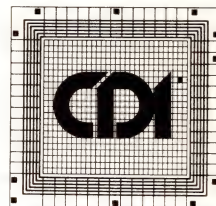


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big cost savings over the typical design lab where several expensive systems are needed. It is *magnitudes* faster than using timeshare with a manufacturer's remote mainframe. One engineer recently said: "I did circuit design work in a half hour on the Daisy; it use to take a week using timeshare."



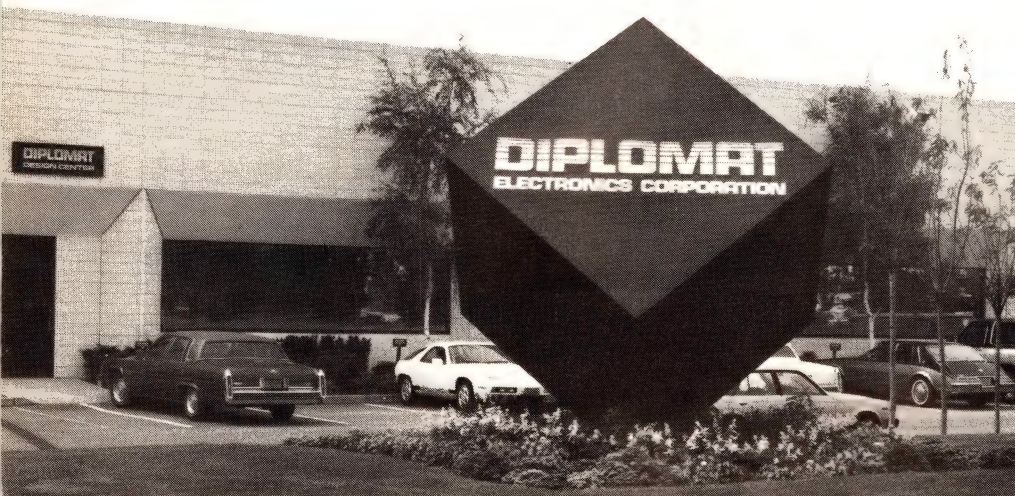
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SPEECH CHIP SPORTS A PAIR OF PROCESSORS

Motorola enters the speech-synthesis business with an 8-bit controller

on the same die as a 16-bit synthesizer □ by J. Robert Lineback

Austin, Texas

When it comes to flexibility and low cost in solid-state speech synthesis, Motorola Inc. believes that two central processing units are better than one, particularly when both are on the same chip. The firm's MOS logic operation in Austin is converting that belief into hardware with the MC6187 voice processor, slated for public announcement next month at Midcon/84 in Dallas.

Twin-CPU chips for other applications almost surely will be turning up in Motorola's catalog in the next few years. In fact, the firm plans to apply the dual-central-processor architecture to a variety of applications requiring very large-scale integration.

Speedy. To date, other speech-chip vendors have offered synthesizers containing a single central processor. Motorola's entry adds an 8-bit microcontroller on the same die as a speedy 16-bit speech processor, which runs at 2.5 million instructions/s.

The two CPUs run independently on microcode software programmed into their read-only memories. This allows customers to select from a wide range of voice-compression rates, speech-synthesizing techniques, and system interfaces.

For example, the 8-bit microcontroller can be programmed to use existing compression formats, such as those offered by Motorola's competitors or required by U.S. agencies. Meanwhile, the microcode of the synthesizer block may be masked to run linear predictive coding, waveform analysis, or continuous variable

sloped delta modulation.

The 8-bit machine on the 2.5- μ m n-MOS voice processor turns out to be the core of Motorola's smallest generic 8-bit microcomputer. That chip, the 6804 [*Electronics*, Dec. 15, 1982, p. 48], is implemented with an internal serial bus structure to conserve silicon area.

The 8-bit block acts as the controller of the entire voice-processor chip. One of its prime functions is to decompress, format, and supply speech data to the synthesizer. It also controls the synthesizer's operational modes as well as handling interfacing to keyboards, outside microprocessors, and the like.

The 2.5-mips 16-bit speech processor has two major parts: a data bus and a microprogrammed sequential microcontroller. The bus consists of a 16-bit-wide 2's complement adder, a 12-by-16-bit 2's complement multiplier, and several registers and random-access memories linked on a 16-bit-wide bus.

The two central processors are linked by an interface made up of a group of registers, making a combination 8- and 16-bit chip. The 40-pin 6187 measures 200 mils on a side and also has packed onto it a number of features, including 4-K bytes of ROM that holds speech vocabulary data, interfaces for external log-



Speech writer. Based on a 68010 microprocessor chip, the VME/10 development system can display digitized speech as waveforms and log-energy plots at the same time.

lary data, interfaces for external logic, a 9-bit digital-to-analog converter, and an operational amplifier.

The on-board ROM is enough for 14 to 28 s of speech. If longer talk time is wanted, the chip can address 120-K bytes of additional speech data stored off chip. For applications requiring d-a circuits with accuracy greater than 9 bits, a digital output register provides processed speech to an external converter.

New approach. With the new chip, Motorola has done more than provide a better way to sound off. The 6187 actually represents a new Motorola approach to single-chip computer architectures. The chip has more active area than the firm's 16-bit 68000 microprocessor.

Motorola's entry into the voice-processing market comes after five

years of work in developing speech technology. Now, it is convinced that synthetic speech markets are at last poised for explosive growth.

"The markets that will really pick up this technology will be the industrial and automotive," says James Binneboese, manager of MOS logic product planning and applications. "That will represent the majority of the growth through the 1990s."

Along with the chip, Motorola is going to market with a 68010-based VME/10 development system, which initially will offer voice-analysis software to perform LPC. Motorola intends to support other voice-processing algorithms. In addition, the 6187 can be programmed to use a customer's own proprietary algorithms, says Amal A. Shaheen-Gouda, senior staff systems designer and one of the

authors of the Midcon paper.

"This is a major IC design, roughly the same complexity of the 68000," notes Tim A. Williams, a senior systems design engineer and also a co-author. He says the chip's development started in mid-1982. First silicon is expected in October, with initial samples slated for the first quarter of 1985. The 6187 will be marketed for all speech applications, but is expected to find its widest acceptance in appliances, as well as automotive and industrial systems that provide information to human operators whose hands and eyes are occupied by other tasks.

In high-volume production, the chips will cost under \$7 each, about half the cost of a two-chip set. The VME/10 speech development system will sell for less than \$25,000.

COMMUNICATIONS

Two small firms are all set to challenge the winning trio in the FCC's paging lottery

Washington, D.C.—The three companies awarded channels for nationwide paging systems after a lottery held by the Federal Communications Commission can expect intense competition not only from each other but also from two other firms that intend to market alternative, less costly systems.

One of those alternative schemes comes from a little-known company called SpanTel Corp., which proposes to use the subcarriers on fm signals to design a network. The other firm, BBL Industries Inc., a manufacturer of paging gear, is encouraging its customers to form regional and national networks before the arrival of single-channel systems.

Winning tickets in the lottery, held late last month, were drawn from among 16 applicants. The winners were PageMemo Inc. of Santa Monica, Calif.; CyberTel-Cox BeepUSA Nationwide Paging Inc., which is 80% owned by Cox Communications Inc. and is based in Fairview Heights, Ill.; and Mobile Communications Corp. of America, a joint venture of National Public Radio

and Western Union Corp. and located in Jackson, Miss. The lottery procedure, however, is under legal challenge by some of the losers, and that could delay startups by the three

winners (see "Lottery losers lodge protest," below).

The FCC granted each of the operators, called network organizers, one 25-KHz channel in the 930-to-

Lottery losers lodge protest

The three winners of the FCC lottery for nationwide paging frequencies could be sent back to square one with their channel assignments withdrawn if efforts by some losers to overturn the agency's ruling succeed.

A consortium called National Message Network, which consists of MCI Airsignal, American Express, and Metromedia, came up as fourth-place loser in the drawing and has filed a petition asking the FCC to reconsider its allocation procedure. "We believe that the commission misinterpreted congressional intentions in using a lottery to select operators for this kind of service," says MCI attorney Richard Severy. It would have been more appropriate in these circumstances if the agency had assigned frequencies to all 16 applicants and then let the marketplace decide which carrier was best.

Should the FCC deny the petition, Severy says the consortium may team up with American Paging Network Inc., a subsidiary of American Telephone and Data Systems Inc., Chicago, to seek a reversal from the U.S. Court of Appeals. APN came in 15th in the lottery but thinks it deserves a channel as it was the only applicant proposing a bilingual service. APN's attorney, Greg Staple, says "It is very unlikely that the court will hear the appeal."

No matter what happens, "MCI plans to be provider of the new service," reports Severy. If it doesn't get a common channel assignment nationwide, it will fashion a paging network in some other way, he claims. —Karen Berney

931-MHz band. Previously, the commission had allowed only local paging and only on a few channels in the 152.24-to-158.7-MHz band. The organizers will act as wholesalers to local TV and radio broadcasters, who will make their transmission facilities available for distribution and sell directly to users.

Satellites. Unlike local paging systems, which rely on telephone lines and radio transmitters to send signals, the nationwide systems will be based on satellites. Pages will be called into a central processing facility for transmission to a satellite and then retransmission to earth stations in the region where the page is supposed to terminate.

From there, the signals will travel by telephone line or microwave to multiple transmitters for distribution. PageMemo's novel design calls for the application of spread-spectrum modulation with message processing software and ground receivers purchased from Equatorial Communications Inc., Mountain View, Calif.

"We see the market growing to 1.5 million subscribers by 1990," says MCCA president John Palmer. Like his counterparts, Palmer is gearing up for a three-way competition. He doesn't pay much heed to SpanTel Corp., of Lincoln, Neb., or the organizing efforts of BBL.

SpanTel, which led the fight to get the FCC to deregulate the use of fm subcarriers, has a different design approach to nationwide paging. Currently, it has agreements with 140 fm broadcasters or subcarrier licensees to use the 67- or 92-kHz channel on their subcarrier to transmit local tone, voice, or digital read-out pages.

Early in 1985, the firm will introduce a frequency-agile pager, to sell for between \$250 to \$300, manufactured by British Sound Recording Ltd., of Hong Kong. The device automatically scans across the entire fm band, finds the appropriate subcarrier, and then locks into the signal if it contains the correct paging code.

With this pager, SpanTel believes it can complete a nationwide network a year and a half from now. "By then we will have 550 fm stations signed on to get geographic coverage for 90% of the potential user population," contends the firm's marketing director, Jim Blue. Though the company will have to

install page-originating terminals in broadcast studios, it will not need to recover the cost of investing in transmitting and receiving stations. Thus Blue says SpanTel can provide the service for \$13.95 per month, compared with the \$30 per month Palmer estimates for his satellite service.

BBL Industries Inc., of Atlanta, Ga., is entering the competition as a supplier of paging equipment that transmits pages by way of satellite or land lines to terminals in distant cities. With this equipment, radio common carriers who now offer local paging services can build regional networks and even expand to national ones, says Wayne Morris, BBL's national sales manager.

All a group of radio common carriers needs to do is agree to page on one of the same channels that already has been authorized for local service, Morris explains. "Our product is going to be extremely competitive with the 900-MHz service."

"We anticipate no competitive threat from nationwide fm paging and only marginal activity of the BBL variety," asserts William Killen, manager of financial analysis and planning for Cox Communications. He maintains fm signals are prone to fade-out and encounter multipath problems in large metropolitan areas. "We don't think the customer is going to pay for a service that is only 90% reliable," he adds.

As for the radio-common-carrier networks, Killen admits that it is a good concept but not one that is likely to succeed nationwide because of practical constraints. "There isn't much of a history of RCCs being able to agree on anything, let alone a common business venture. It is a fractured and splintered industry." But Morris retorts that several of them in the Southeast are already involved in the creation of wide-area networks that could grow into a national service. —Karen Berney

MICROCHIP APPLICATIONS

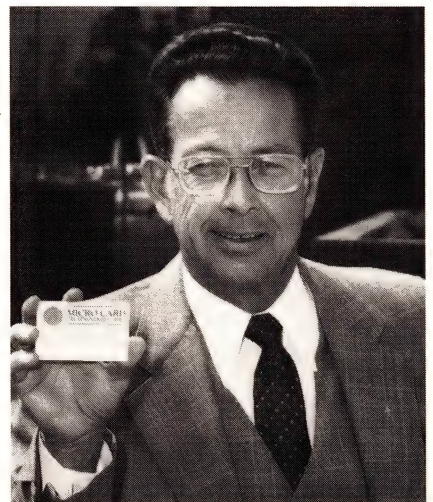
Smart cards, in new U.S. bid, aim at high-security uses

Dallas—Billed as the most personal of all computers, integrated-circuit-based smart cards are still waiting for their number to come up in U.S. credit, banking, and retail circles. So far, cheaper magnetic strips on the backs of plastic cards continue to hold the upper hand in U.S. electronic credit and banking markets.

But a new Dallas subsidiary of a French smart-card pioneer hopes to change all: Micro Card Technologies plans to manufacture the product in the U.S. and aggressively take aim at emerging applications that require higher levels of security and flexibility. As its use grows, the chip-embedded credit card will become more price-competitive with the firmly entrenched magnetic-strip technology, believes Richard L. Dunham, president of Micro Card Technologies, which is promoting the 8-bit CP8 smart card developed by its French parent, the Bull Group.

This month, Micro Card Technol-

ogies signed its first major contract, to provide CP8 cards for a drug-interaction system from Medication Services Inc., Menlo Park, Calif. When inserted and activated in a



In the cards. Micro Card Technologies' head Richard L. Dunham aims to make his firm's smart card the credit card of the future.



In the cards. Micro Card Technologies is taking aim at emerging markets with the CP8 smart card. Developed in France, the card incorporates an 8-bit microprocessor.

slot on a terminal, the smart card's 8-bit microcomputer chip will process and store patients' medical records in on-board memory as well as track drug usage, notes Dunham.

The drug-tracking system isn't the first use of CP8 cards in medicine. For two years, Amrix Corp., Houston, has been offering CP8 cards and reading-writing peripherals, which are integrated into IBM Corp. and IBM-compatible computers. Amrix, which makes systems for hospital-automation consultants, gets its CP8 cards from Honeywell Information Systems, which owns 8% of Bull.

Secure system. Micro Card Technologies is also wooing computer hardware firms, promoting the CP8 and card-slot hardware as the best way to offer information systems security. The firm also is marketing CP8 for facility control applications, where the card would be used to open doors.

To crack the huge U.S. credit card market, however, Micro Card Technologies is banking on the increased competition among lending institutions to attract affluent customers. In order to lure wealthy customers, banks "are offering more services, but that is a dichotomy because they have the fraud problem with just the basic go-out-to-dinner credit card," says Dunham. Placing stock services, home banking, and travel services on credit cards increases the security

risk, he suggests, adding that annual losses in that industry top \$1 billion.

Unlike magnetic-strip cards, which hold only stored data, smart cards can process and encrypt their own data without going on-line to a main-frame data base. Thus on-board read-only memory can hold a number of security features that protect passwords, checking account balances, and other sensitive records. The 30-mil² n-MOS CP8 chip, for example, has 21-K of storage, of which 8-K can be used to store up to 250 transactions.

Card holders can set their own four-digit log-on number, which will automatically turn off the card if not entered correctly on the third try. The CP8 card can be reset only by the issuing institution. The intelligence of smart cards also allows one piece of plastic to replace a fistful of conventional cards.

Barriers. Despite some initial success in France [*Electronics*, Jan. 26, 1984, p. 92], smart cards still face a number of barriers in the U.S. Perhaps the greatest of these is regaining public credibility after the overblown promises of promoters in the past, complains Dunham.

"They were talking about the technology with half the facts and no equipment to back it up," he says. "This probably gave the smart card a false start here." But Micro Card Technologies has already started

shipping samples to a number of interested terminal makers and financial institutions.

By the end of 1985, the firm plans to start mass production of the CP8 card in the U.S. Dunham believes smart credit cards initially will appear with magnetic strips for use in existing card-reading terminals. "Once the [smart] credit card starts to take off, it will take five years to reach most segments because of the size of the market," he says.

Micro Card Technologies may not be alone for long. SmartCard International Inc., New York, which has licensed the Bull technology for the past year, is expected to soon announce a manufacturing pact to also produce smart cards in the U.S.

Cost factor. But price is still a significant hurdle for chip-based cards. Magnetic-strip credit cards cost between 50¢ and 70¢ each, while in similar high volumes the CP8 card is expected to cost about \$3.50 to \$4. To help develop the U.S. market, Bull has licensed the CP8 technology to Philips Data Systems, Paris, which had been promoting its own two-chip smart card system.

"It will never really be as cost effective as magnetic strips in certain applications. But then again, the distributed microcomputing system associated with chip cards is less costly, since transactions are done completely off-line," notes market researcher Steve Szirom, president of HTE Management Resources, in Sunnyvale, Calif.

Recent HTE studies of checking-account costs in France indicate that a smart card must be in the \$2.50-to-\$3 range before making it a workable alternative to paper. Szirom suspects the cost might have to be lower in the U.S., because check processing here is more highly automated.

An emerging competing technology is the optical storage strip—such as Drexon, promoted by Drexler Technology Corp., Mountain View, Calif.—which holds more data than the magnetic medium but has no computational capabilities [*Electronics*, June 30, 1983, p. 110]. "You might call it a 'dumb storage' card instead of smart card," Szirom adds.

To date, trials in the U.S. have been less than encouraging. Most recently, the U.S. Department of Agriculture elected to use magnetic-strip

cards over smart cards in an experimental electronic replacement for food stamps. The USDA's Food Nutrition Service plans to begin the electronic benefit transfer program Oct. 1 with 4,000 food stamp recipients and 100 food stores in Reading, Pa. Cost was a key strike against the smart card.

The Department of Defense has concluded Rapids, its real-time automated personnel identification sys-

tem project, and is now studying results from the tests on both magnetic-strip and microchip cards [*Electronics*, March 10, 1983, p. 50]. Rapids is aimed at a larger effort to automate the DOD's central data base, known as the defense enrollment eligibility reporting system, or Deers. Input Output Computer Systems Inc., in Bethesda, Md., the systems integrator for the Rapids project, says no decision has been made

on which technology to use, but the DOD is studying bids for microcomputers that will be used to update the real-time data base environment.

The smart-card technology under evaluation is Philips' two-chip system, which some project leaders admit may have more capabilities than the system can use. But to get into the commercial market as soon as possible, Philips has taken a license for the CP8. —J. Robert Lineback

TEST AND MEASUREMENT

Instrument uses spectra-radiometer to throw light on height of the flying head in a hard disk drive

Burbank, Calif.—Makers of hard disk drives, an intensely competitive crew that seldom sees anything the same way, can find agreement on one topic. They concur that measuring the flying height between the read/write head and media surface is a ticklish and time-consuming chore. Furthermore, it is getting even tougher as the gap narrows below 10 $\mu\text{in.}$ so that the head can better access tightly packed data bits on ever-higher-density disks.

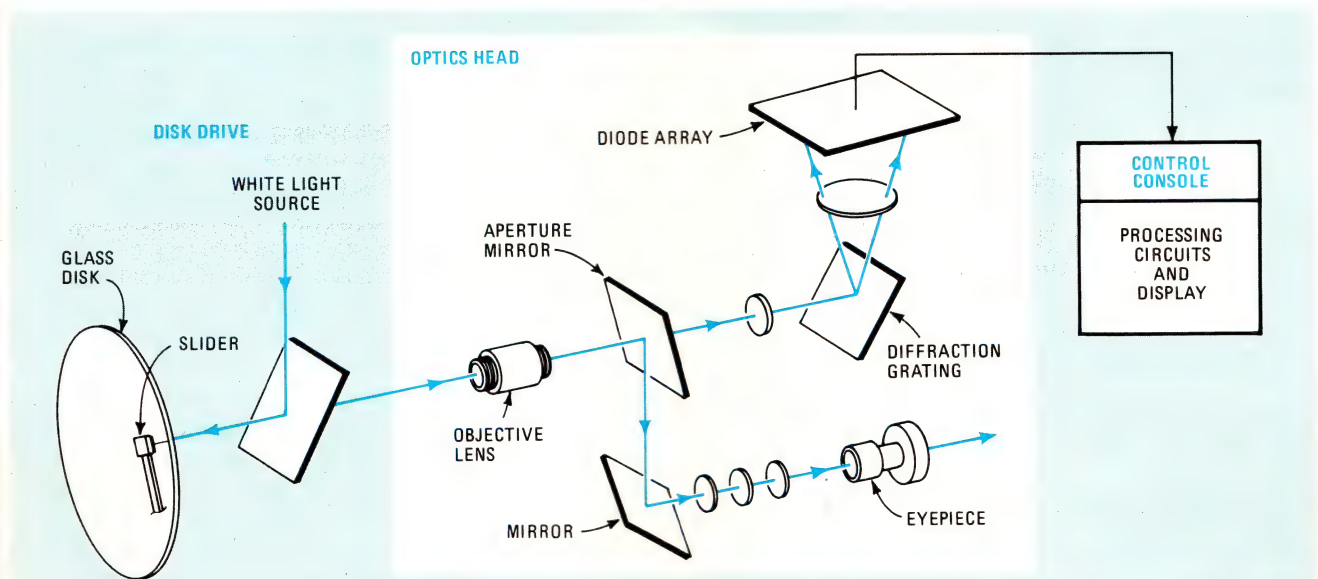
Although ways of doing the job vary widely among manufacturers and users, all of them require an ex-

perienced operator who can interpret measurement data. Developing equipment that obviates interpretation has a high priority, industry sources say. Thus the interest in a new system that, according to its builder, will automatically measure the height accurately within 4 $\mu\text{in.}$ with no chance of operator errors.

Interference. Developed by the Photo Research Division of Kollmorgen Corp., the SpectraScan employs interferometry techniques along with a dedicated algorithm to calculate and digitally display the flying height distance in seconds.

According to Photo Research vice president Kenneth A. Miller, the instrument has so piqued the interest of disk drive manufacturers in private showings that several bought it before its late-August public unveiling at the technical symposium of the Society of Photo-Optical Instrumentation Engineers (SPIE) in San Diego. The attractions are twofold. Not only does the SpectraScan get rid of visual interpretation but it also "achieves accuracy that exceeds industry practice by nearly tenfold, better than 0.3 $\mu\text{in.}$," Miller says.

In building its SpectraScan, the



Height by light. White light beamed into the tiny gap between a glass disk and slider creates an interference pattern that is "read out" by an array of photodiodes, each sensitive to a narrow frequency band. The diodes' output is analyzed on the control console to determine the height.

Burbank group took as the starting point a standard white-light interferometry technique that was introduced several years ago by IBM Corp. researchers and is still used widely in measuring the height distance.

The technique involves focusing a white light source—a tungsten or xenon lamp—on the separation between a transparent quartz disk and the slider of a recording head to generate an interference color pattern. Operators then estimate the flying height by observing the color changes taking place as the disk rotates, comparing them with the classic Newton interference color scale. “A lot of judgment taking place there,” notes Miller.

Diode array. Photo Research uses the same principle, but substitutes proprietary hardware and special algorithms for human judgment. It modified a scanning spectra-radiometer and added a Z80-based processor for the computations. An array of 256 diodes monitors the visible light spectrum, each one corresponding to a narrow part of the band from 290 to 730 nm. Thus the color and intensity of color pattern, indicating the height distance, can be determined precisely.

In operation, an optical setup focuses the white light on the separation, deriving two measurements: one from the quartz disk surface and one from the head-disk gap itself. The reflected wave amplitudes from these surfaces produce the interference pattern, the color variation of which pinpoints the height. The computer stores the data, calculates the distance with the algorithm, and then displays the result. All the operator has to do is make the test setup, but there's an auxiliary viewing system nonetheless.

The Burbank company plans to sell the equipment for about \$30,000 each, plus another \$15,000 or so for tailoring the algorithm to each customer's needs.

As for disk drive manufacturers' view of Photo Research's development, Alonzo A. Wilson, executive vice president of Priam Corp., San Jose, Calif., voices a representative comment. “If this is for real—coming up with a mechanized way to get a digital readout of flying height—it is something of interest to the indus-

News briefs

Chip book-to-bill ratio slips further

The closely watched book-to-bill ratio for the semiconductor market continued downward in July, slipping to 1.06:1 for the month. The preliminary survey of key manufacturers in Japan, Europe, and the U.S. by the Semiconductor Industry Association found shipments at \$912 million, a 13% drop, and bookings at \$1.048 billion, down nearly 9%. But SIA officials aren't worried. SIA president Thomas D. Hinkelman notes that the year is shaping up much like 1979, when the U.S. market grew 37% despite similar drops in July, which is most often a slow month. “Just as the 1979 seasonal decline had little or no impact on the overall growth rate for the year, the current decline is not expected to affect the more than 40% increase which we project for 1984,” he says.

Japan's personal computer exports to U.S. show sharp gains

Japanese personal computer exports to the U.S. are taking off. Mitsubishi Electric Corp. and NEC Corp. report U.S.-bound shipments four times those of 1983. Mitsubishi estimates it will ship 80,000 units in 1984, mostly original-equipment manufacturer models for Sperry Corp. NEC, selling under its own name, expects total U.S. exports of 40,000 units, mostly its IBM-compatible 16-bit APC III. Sord Computer Corp. predicts U.S. sales of 50,000 units, half under its own brand and the remainder OEM units for various firms.

TI forms microprocessor division for 32-bit thrust

Texas Instruments Inc. is picking up the general-purpose microprocessor development and production activities it dropped several years ago. The Dallas company has announced that it would create a Microprocessor Division on Houston's southwest side, site of its MOS Memories and Programmable Products divisions. The new division will give microprocessor products higher visibility and autonomy following last spring's agreement to second source the 32-bit 32000 family from National Semiconductor Corp., Santa Clara, Calif. Breaking with its philosophy of home-grown management, TI has been recruiting heavily in the Boston area and Silicon Valley for seasoned microprocessor engineers and marketing personnel; hundreds of slots are being filled. TI Semiconductor Group vice president Gerald D. Rogers, who headed the Programmable Products operation, will manage the new division.

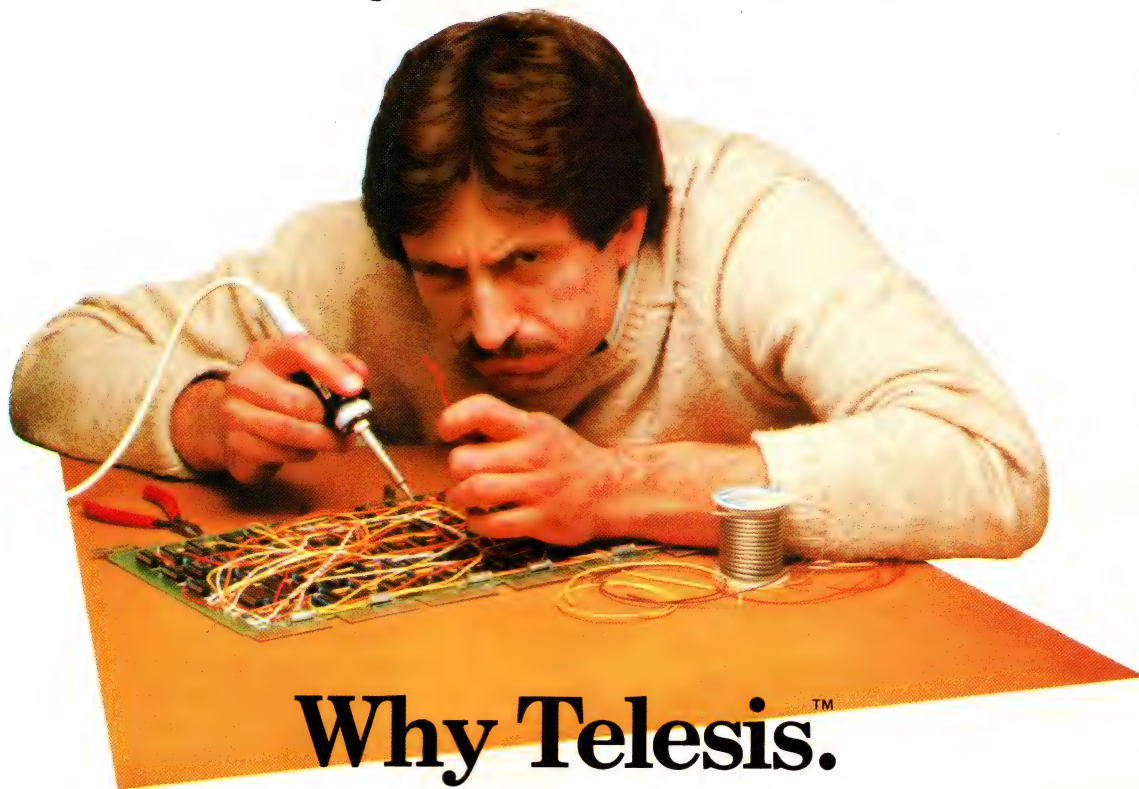
ITT-Hungary digital-switch deal poses Cocom problem

A recent letter of intent won by ITT's West German subsidiary, Standard Elektrik Lorenz, to supply System 12 digital telephone switches to Hungary could pose a severe test for the unity of the members of the Paris Coordinating Committee (Cocom), which examines sales of Western technology to Soviet bloc countries. The letter appears to directly oppose an accord reached last month by the 15-member committee forbidding sales of electronic telephone exchange equipment to Warsaw Pact nations until at least 1988. An ITT spokesman says the company intends to find a way to satisfy both the agreement's requirements and the Cocom directives, although industry sources are skeptical of the U.S. company's chances of doing so. One tack SEL is considering is simply to defer shipment of the switches until 1988, when Cocom has agreed provisionally to ease the ban on telecommunications sales.

Sumitomo counters in optical-fiber battle

Determined to get into optical-fiber production in the U.S., Sumitomo Electric Industries Ltd. has gone to court to clarify its right to operate its \$50 million plant in Research Triangle Park, N.C. Corning Glass Works, Corning, N.Y., last year sued the Japanese company for patent infringement in Canada. In its complaint filed in Federal District Court in Greensboro, Sumitomo Electric Research Triangle Inc., a subsidiary of the Osaka firm, alleges Corning's patents are unenforceable. What's more, Sumitomo says that its fibers, with a core of pure silica and a cladding doped with fluorine (for lower index of refraction), are made by a process that doesn't infringe on Corning patents.

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Circle 23 on reader service card



try," he says. Taking an operator out of the test procedure is especially appealing to Wilson, whose company will be attempting to pursue automation as far as possible in its new plant.

Photo Research's Miller says feedback from several large drive manufacturers is heartening. "They say a lot of work has gone into this problem, but ours is leaps and bounds ahead."
—Larry Waller

ROBOTS

Advances in software systems may bring integrated robotics

Bethlehem, Pa.—Although there are about 8,000 robots working in the U.S. today, the software systems to integrate them adequately with humans have yet to be developed. Some 300 manufacturing engineers, researchers, and executives tackled this problem at the conference on robotics research held at Lehigh University in mid-August.

Entitled "Robotics Research: The Next Five Years and Beyond," the meeting was sponsored by Robotics International of the Society of Manufacturing Engineers, Dearborn, Mich., and included the presentation of 29 technical papers on a wide range of research topics, including robot software systems.

The future. "We can expect new and more advanced robot software," predicted Roger N. Nagel, director of Lehigh University's Institute of Robotics. The field is moving so fast, he says, that researchers are tackling new problems without solving preexisting ones.

Among the current research objectives are full-structured computer languages, extensions for robot motion and control, sensor communication and control, three-dimensional manipulation and reasoning, database access and communication, and operating system support. "No such robot software product is available today," notes Nagel, "but researchers are developing the pieces."

Ultimately, the instructions given to industrial robots would be the same as those now given to an assembly worker for such tasks as packaging or shipping, he explains. This would require software systems that incorporate 3-d geometry for path planning and object gripping,

and that include collision avoidance and detection programs.

"Many of the robots in factories today use an augmented teach-box programming methodology," Nagel explains, but these systems don't create robot programs, detect collisions, or simulate sensors. This teach-box method, along with graphics and a more sophisticated manipulator language, is the basis of the software systems that will eventually be used, Nagel predicts.

"No language or software package in use today is task-oriented," adds Robert B. Thornhill, manager of the Robot Product Center at Martin Marietta Data Systems, Orlando, Fla., in explaining CAM-I, a robotics software project. However, "some high-level languages exist that offer several advanced capabilities as stepping stones." Among them are Unimation Inc.'s VAL basic language and SRI International's AL and RPL robot programming languages.

The CAM-I project, established in 1972 and based in Arlington, Tex., was created to "develop prototype software for a robot planner for total programming of the robot or robot-tended work cell in an off-line graphic mode," says Thornhill. He thinks the ideal off-line graphic programming system for robot work cells is still several years away, but he notes that both Japanese and West German firms are now working in partnership with American companies in order to attain this software-systems goal.

The prospects for computer-integrated manufacturing appear to be bright. "CIM is revolutionizing the design and manufacture of products," Thornhill told the conference. But according to Nagel, the impact of this new development on the assembly of electronic components may not be as great as it has been on heavier manufacturing, despite the growing precision and improved repeatability of industrial robots.

Challenging. The most challenging problem in developing robot software is the definition of interfaces, such as sensors and data bases, says Nagel. Along with this, "We need to get more of the artificial intelligence community working on robotics."

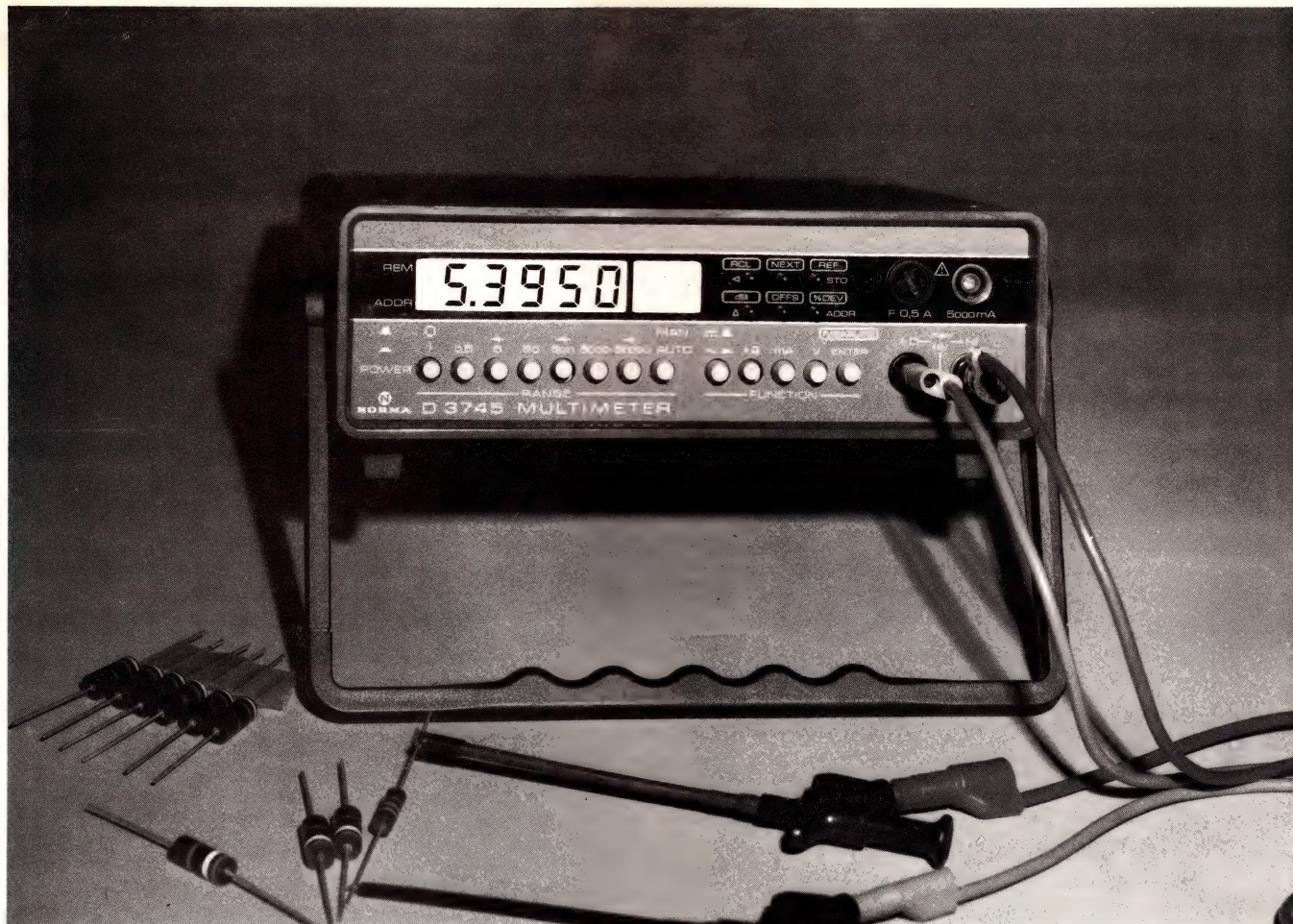
The question is whether all this activity will lead to some kind of robot software standardization. According to Nagel, defining such a standard was the original intent of the CAM-I project. If it were to get wider acceptance, he predicts, CAM-I could become the *de facto* standard.
—George Leopold

MICROCOMPUTERS

Signetics plans to offer a 32-bit memory controller

Sunnyvale, Calif.—Signetics Corp., one of the junior partners in the group of companies supporting the Motorola Inc.'s 68000 microprocessor family, may have stolen a march on the others in its bid for the rights to make the top-of-the-line 32-bit 68020. The company late this month announced a Memory Access Con-

troller (MAC) that performs the much-needed function of mediating all access between the microprocessor and system memory. If, as Signetics hopes, the chip becomes the *de facto* standard, it will give the firm added leverage in negotiating a second-source deal with Motorola for the 32-bit 68020.



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	2 mA-200 mA	200 mV-600 V	
D 2230	20 nA-200 mA	200 mV-600 V	2 k Ω -2 M Ω
	2 mA-200 mA	200 mV-600 V	
D 3210	200 μ A-20 A	200 mV-2000 V	200 Ω -20 M Ω
	200 μ A-20 A	200 mV-2000 V	
D 3220 RMS	200 μ A-20 A	200 mV-2000 V	200 Ω -20 M Ω
	200 μ A-20 A	200 mV-2000 V	
DA 3232	200 μ A-20 A	200 mV-(2000 V)	200 Ω -20 M Ω
	200 μ A-20 A	200 mV-(2000 V)	
D 3745 IEEE 488	0.5 mA-5 A	0.5 V-1000 V	500 Ω -50 M Ω
	0.5 mA-5 A	0.5 V-1000 V	
D 4025 IEEE 488	250 μ A-2.5 A	250 mV-1000 V	25 Ω -25 M Ω
	250 μ A-2.5 A	250 mV-1000 V	
D 4045 IEC 625	250 μ A-2.5 A	250 mV-1000 V	25 Ω -25 M Ω
	250 μ A-2.5 A	250 mV-1000 V	

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xxxx Address 0 breakpoint 1 xxxx

00 32FFFFF	04 FFFF777	08 FFFFFFF	0C FFFFFFF	10 0000000
01 0000000	05 FFFF777	09 FFFFFFF	0D FFFFFFF	11 0000000
02 FFFF777	06 FFFF777	0A FFFFFFF	0E FFFF777	12 0000000
03 FFFF777	07 FFFF777	0B FFFFFFF	0F FFFF777	13 0000000

Heap stack +0 2700 +2 7007 +4 0000 +6 0040 +8 0201
System stack +0 2935 +2 FFFF +4 2932 +6 1020 +8 0201

Supervisor Program

00200C 040501050104	SUBT.L 001050104, 05
00200E 000401050004	INT.L 001050004, 04
002012 009500050105	INT.L 001050105, 05
002018 0104	BCLR 00, 04
00201C 040501010005	SUBT.L 00110005, 05
002020 020004000004	DMUL.L 00+000004, 04
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Circle #26 for Literature
Circle #27 for Demonstration



Write-once 8-in. TV laser disk plays 13 minutes of sight and sound

Motorola will grant licenses to second-source the 68020 only to members of the group—Signetics, Mostek Corp., Thomson-CSF, and Hitachi Ltd.—who design peripheral chips of comparable value. The MAC has some claim to such value since the full power of the 68020 will be accessible to systems designers only when chips are available that can manage its full 4-gigabyte virtual address space.

Motorola's 32-bit rivals already have this capability: the Intel Corp. 80286 on the microprocessor itself, and the National Semiconductor Corp. 32032 with a demand-paged slave processor, the 16032. Motorola has come up with an interim solution to the memory management problem utilizing a custom logic array [*ElectronicsWeek*, Aug 6, p. 44], and will have a CMOS page memory management unit available next year.

The Signetics MAC provides automatic virtual-to-real memory address translation, and in addition gives the designer complete flexibility to partition memory in pages, segments, or any combination of the two, and to access its large, 32-K-byte cache memory without wait states.

Two chips. Signetics actually has two MACs—the 68910 to work with the 16-bit 68010, and the 68920 for the 68020. It is the latter chip, however, that is most useful for multitasking and multiuser applications, and therefore is in most need of memory management.

"The MAC will make the 68020 run the way it should," says Guy Thompson, applications manager for Signetics' Microprocessor Division. One example: the large cache, for which Signetics claims "hits" in the 90% range (90% of memory accesses found in the cache) allows more than one processor to be used on a system bus without significant degradation. In effect, each processor has its own local memory.

The Signetics chips will be available in the second quarter of 1985, about the same time as Motorola's 68851 CMOS chip. However, in December Signetics will have available a basic MAC chip that provides all the MAC functions but requires a host microprocessor. The BMAC will be a development tool that can be directly replaced by the MAC in a working system. —Clifford Barney

Osaka, Japan—Again, a Japanese consumer manufacturer has demonstrated the beauty of a bottom-up approach, with technology developed for consumer electronics making a large contribution to a high-tech product. Matsushita Electric Industrial Co. has introduced a system for optically recording and playing back 13-1/3 min. of color video with stereophonic sound on 8-in. disks.

The setup uses two linear integrated circuits originally developed for video cassette recorders, which speeded up development and reduced production costs. Direct access to individual frames is provided; it is possible to record 24,000 individual frames if the user prefers still frames to motion video.

Nonerasable. The system is designed for one-time laser recording on pregrooved disks coated with a thin-film layer of tellurium oxide approximately 1.20 nm thick. As deposited, the layer is amorphous and has a reflectivity of about 10%. But

when a beam with a power of about 9 mW at 830 nm is applied to the disk from a 25-mW laser, it changes the layer to a crystalline structure with a reflectivity of about 20%.

Erasure is not possible; for playback, the laser output is reduced to 3 mW. (A companion unit designed for playback-only uses just the smaller laser.)

VCR-based. Signal format is similar to VCR tape with the video luminance signal recorded as a frequency-modulated carrier. The chroma signal is shifted to a low-frequency subcarrier at 629 kHz—the same as in VHS recorders—while the two stereo channels are FM subcarriers at 1.3 and 1.5 MHz.

Use of a VHS chroma chip helps solve the problem of crosstalk between chroma signals on adjacent tracks by a method similar to that used in standard VHS recorders. This crucial development made it possible to decrease track pitch to 1.6 μm from the 2.5- μm spacing



Flexible recording. Matsushita's optical record/playback system permits the user to record 13 min of TV with stereo sound or 24,000 still frames. Low-power laser does the writing.

used on earlier laser-disk systems for recording single television frames.

The higher track density gives a 60% increase in disk capacity. Although the new system features a single spiral track and the old system used concentric circular tracks, disks made by old systems can be played back on new ones.

Crosstalk in luminance and audio channels is much less of a problem because FM detectors tend to be captured by the strongest signal. But use of an IC that was developed for high-fidelity VCRs [*Electronics*, June 16, 1983, p. 82] has helped to keep the price down.

Frames can be written on a disk at any time in any desired order, Matsushita says. Access time to any frame on the disk averages 0.5 s. Front-panel control, TV-type remote control, and computer control through a built-in RS-232-C interface are all available. They can also select among standard speed, slow motion, and fast motion—or sequences of these modes.

Applications are expected to run the gamut from product catalogs, to various types of medical imaging [*ElectronicsWeek*, Aug. 6, 1984, p. 34], to flight simulators, and TV broadcast and movie real-time play-

back or editing to another medium.

Demand in the U. S. is expected to exceed that in Japan, and sales will be started at the same time—September for a read-after-write unit, and November for a playback-only unit. The price in Japan is set at \$14,300 for the unit with recording capability (model TQ-2300F), and at \$3,500 for a playback-only unit (model TQ-2400F).

Users will also be able to combine one recording unit with several playback units for certain editing applications. Disks will be about \$25 each, but will get less expensive as production picks up. —Charles L. Cohen

PACKAGING

Power MOS FET pair in custom package generates kilowatt pulses in nanoseconds

Livermore, Calif.—When designers need to generate a surge of power at blinding speeds—say, 10 kW at several hundred volts in less than 3 ns—vacuum tubes come immediately to mind. But the planar triodes that can do that sort of job cost some \$400, a strong incentive for power semiconductor designers to seek a much less costly solution.

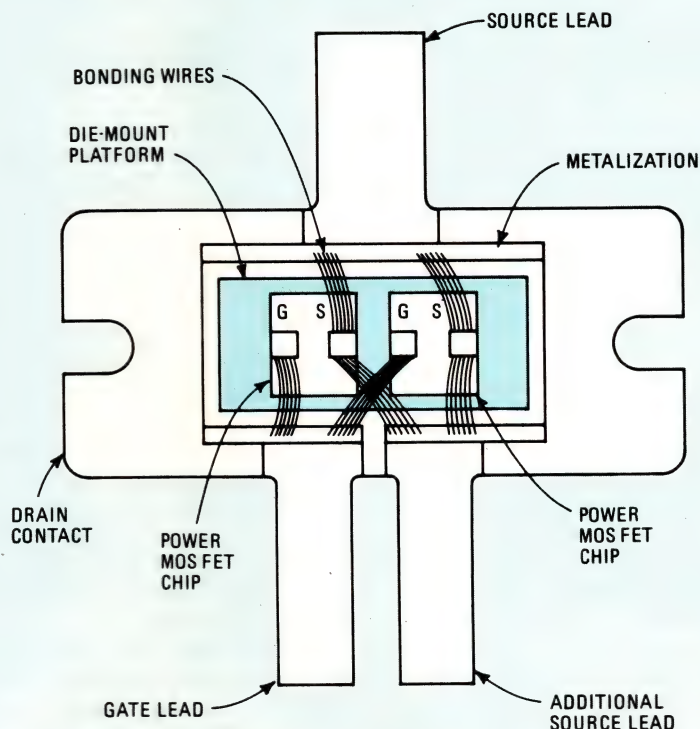
In a joint effort, researchers at the University of California's Lawrence Livermore National Laboratory and the Los Alamos (N.M.) National Laboratory have found a \$100 solution. "It's a classic case of replacing a tube with a transistor," says Jeff Oicles, a project engineer at the Livermore lab.

Oicles and George Krausse, his counterpart at the Los Alamos lab, made possible the replacement by bonding together two \$15 power MOS FETs in a special microwave strip-line package. Using the special package adds \$60 or so more to the cost of the part.

Built using IRFC440 chips from International Rectifier Inc., their

"semi-optimized package," as Oicles describes it, has achieved experimental switching speeds of 1.3 ns under lightly loaded conditions of 400 V into 50 Ω and single-device peak cur-

rents of 145 A in about 5 ns. Based on their current experience, they predict single-device maximum currents of 200 A, rise times of less than 1 ns, and voltage hold-off ability of at



Doubled up. Lawrence Livermore researchers put two power MOS FET chips in a single package for a fast-pulsing combination. Bundles of tiny wires interconnect the chip pads and the package, keeping inductance low.

least 1 kV as power MOS FETs improve. Essentially, the package devised by Oicles and Krausse can do the job because it lowers the inductances through which the gate-source capacitance and the drain-gate reverse capacitances are charged. This is done partly by utilizing groups of

caused by a positive pulse at the source. An extra set of bond wires leading to each transistor connects the extra lead to the chip (see package drawing, p. 29).

Oicles and Krausse point out that other manufacturers' devices should perform equally well when adapted into this packaging. They note that power MOS FETs with switching speeds typically rated at 20 ns can easily achieve switching speeds 10 times faster with their technique.

That possibility has triggered some interest from electronics equipment makers, but Oicles nonetheless foresees no main-line use of the technology. Instead, he says, applications will come in more offbeat applications such as marine communications, particle accelerators, low-power lasers, cancer-treatment equipment, military countermeasures equipment, nuclear testing, and university research. —Eve Bennett

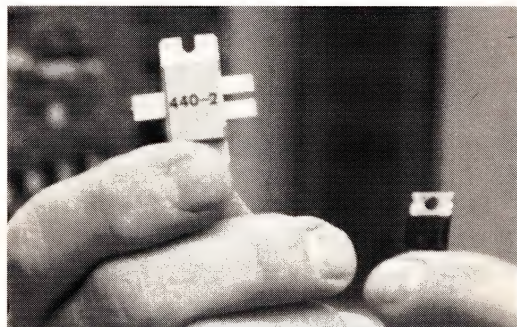
such as dry etching and microlithography. Naturally enough, the big-league companies have cornered all the process development contracts, but small companies, such as Bristol-based Plasma Technology Ltd. (see "Britain pushes dry-etching technology," opposite page), also have a key role to play in the program.

Central to the fifth-generation push is the very large-scale integration program, penciled in by an 11-member industry committee under the direction of John Alvey, technical director of British Telecom [*Electronics*, May 31, 1983, p. 102]. This program will span software engineering, intelligent knowledge-based systems, man-machine interfaces, and VLSI technology. VLSI technology accounts for a little under a third of Alvey's fund of \$448 million. Basic process techniques needed for microlithography and the like claim 52% of the VLSI funds, while process development is in for 36%; the remaining 12% will go to such new approaches as wafer-scale integration.

Britain's vertically integrated semiconductor manufacturers—General Electric, Plessey, Ferranti Electronics, and Standard Telephones and Cables—dominate the allocation of process development funds. Absent, however, is Inmos Ltd., now part of Thorn EMI plc. Information Technology Minister Kenneth Baker attributes this to the fact that Inmos's process technology was developed in the U.S. Its transputer and computer-aided design software will both play major roles in the Alvey fifth-generation program.

A late entrant to the Alvey program is STC, which has teamed with Britain's Racal Electronics plc, British Aerospace plc, and the University of Leuven, in Belgium, for the development of a CMOS process with 1.5-to-1.25- μ m resolution. According to Geoffrey Lomer, Racal's technical director, the STC process is basically simpler and less ambitious than a CMOS process under joint development by Plessey and GEC, and thus it can be developed quickly. "That's what the process industry is screaming for," says Lomer.

Plessey and GEC's CMOS process will be developed in two stages.



Power pack. Two MOS FETs packaged in an adapted strip-line package that adds a second source lead (left) generate kilowatt pulses in less than 3 ns.

ten 2-mil wires to connect the pads on the chip to the package terminals.

Also important is the addition of a second source lead for a floating gate drive, which reduces the feedback

SOLID STATE

Britain's fifth-generation program pushes limits of its IC technology

London—The British fifth-generation computer directorate has thrown five rapid semiconductor processes along with a bevy of university and other research laboratories into a race to put 1 million devices on a single chip of silicon by 1989, using only native technology.

The five chosen processes are intended to demonstrate production-ready circuits with 1- μ m feature sizes within five years. The goals of the \$81 million program are:

- Two complementary-MOS processes: a quick-development two-layer metal process with a 1.25- μ m feature size, and a second, more advanced process, with up to four interconnect layers and a smaller 1- μ m feature size. Clock speeds would be up to 130 MHz.

- A collector-diffused isolation (CDI) bipolar technology with 1- μ m

feature size, able to put a 100,000-gate array on a 350-mil² chip. Such an array would consume 2 W and have a typical gate delay of 1 ns.

- An ultrahigh-speed bipolar process with 1- μ m feature size and gate delays of around 50 ps. This yields a 5-gigabit/s clock rate and attains gallium-arsenide-like speeds.

- A 1- μ m CMOS silicon-on-sapphire process for radiation-hardened and high-performance military applications, with clock speeds up to 140 MHz. Gate densities typically would be 30% higher than bulk CMOS and power consumption roughly 20% lower.

Industry effort. The development of these five key processes is supported by a broadly based industry effort, involving 15 companies and 24 university and other laboratories, to develop 14 process techniques

Britain pushes dry-etching technology

Broad research into some 14 techniques needed for submicrometer very large-scale integrated-circuit technology, such as device and process modeling, dry etching, and microlithography, will underpin Britain's VLSI effort. The directorate, led by John Alvey, technical director of British Telecom, has now let contracts in 10 of the most critical of these areas; further contracts covering the remaining areas, such as packaging testing and automated wafer fabrication, will follow later this year.

The Ministry of Defence's Very High Performance Integrated Circuit program [*Electronics*, July 14, 1982, p. 98] had already worked out much of the groundwork for the program. William Fawcett, who directs Alvey's VLSI program, was seconded to the directorate from Britain's leading defense laboratory, the Royal Signals and Radar Establishment.

Large laboratories play a central role here; British Telecom's Martlesham Research Laboratory, for example, has contracts worth \$28 million for research into dry etching, electron-beam resist development, failure analysis using scanning microscopy, and multilevel interconnection. But small firms and universities can shine, too.

Plasma Technology (UK) Ltd., a Bristol company specializing in plasma etching and definition systems, and Nordiko Ltd., another small company based in Hampshire, both

have novel and imaginative ideas in dry etching. Dry or plasma etching can sculpt very fine features with sharp edge profiles and fewer contamination problems than is possible with conventional wet etching.

Plasma Technology is involved in three collaborative contracts worth \$650,000. One contract is for prototype gear to plasma etch refractory metals and their compounds with silicon, since nothing of that type is available commercially. Refractory metals such as titanium, tungsten, and molybdenum will be used in place of aluminum in the next generation of VLSI circuits because of their low resistance and high-temperature stability.

Another contract is for developing techniques of plasma-etching chrome masks with 1- μ m features. A third contract, involving three major IC manufacturers and a university, is to develop a new generation of reactive ion etch machines. Reactive ion etching is a more sophisticated form of plasma etching that uses electrically accelerated ions to give a directional etching effect. The project will use a microwave-generated plasma to increase the etch rate and a variable accelerating voltage to control the direction of attack.

The outcome could be the development of an advanced dry etching capability in the UK with a strong infrastructure of equipment, material, and knowledge to support it, says Alvey.

—Kevin Smith

GEC will develop a basic 1.5- μ m process to permit evaluation of design techniques, CAD tools, and demonstrator circuits before the final process is available. Meanwhile, Plessey will develop the advanced features process with up to four-layer interconnections, also at 1.5- μ m. The processes will then be scaled to 1 μ m.

Ferranti Electronics plc, in Oldham, is charged with developing a general-purpose bipolar process around its unconventional, but effective, collector-diffused isolation technology. The company has long figured that this technology, with its process simplicity and 1- μ m dimensions, can compete with CMOS technology. It uses six masking steps, compared with the 10 typical for CMOS processes, on a wafer having a flat, warp-free surface, ideal for carrying 2.5- μ m pitch tracks. A 100,000-gate array, Ferranti believes, could be put on a chip of just 350 mils²—380 mils² if auto-routing were employed. Gate delays would typically be 1 ns, but Ferranti has produced circuits running at 350 ps in the laboratory.

That's fast, but the one to beat in the race for blazing speed is the

Plessey Co. plc's ultrahigh-performance bipolar process with 50-ps gate delays. This would be sufficient to run front-end logic in, say, a fiber-optic link or converter at up to 5 gb/s, and it moves silicon technology well into the speed realms of GaAs.

Caswell is already well down that road with its high-performance 3- μ m oxide-isolated process that produces 250-ps gate delays and synchronous logic operation up to 1 GHz. "The next stage is to add polysilicon emitter structures and reduce feature sizes," says Bill Holt, general manager of the Integrated Circuit Division at Plessey's Allen Clark Research Centre. The polysilicon emitter, well known in MOS technology, offers a breakthrough in high-frequency performance by enhancing emitter injection efficiency in bipolar form.

Rounding out the processes is a CMOS silicon-on-insulator technology under development at GEC's Hirst Research Centre. Development work has already been carried out on a 3- μ m process, soon to be transferred from Hirst to Marconi Electronic Devices Ltd.'s Lincoln production unit.

Meanwhile, work will get under way on 1.5- and 1- μ m versions of this process. GEC is also the anchor for Britain's SOI program [*ElectronicsWeek*, Aug. 6, 1984, p. 31], which is aimed at developing cheap SOI substrates. If this Alvey-supported technique should prove workable, GEC will very quickly move its CMOS-SOS technology to the new substrate medium.

—Kevin Smith

CONSUMER

Chip speeds tuner alignment

Freiburg, West Germany—Television set makers will find the job of producing capacitance-diode-based TV tuners much easier and less time-consuming. Soon they will have an integrated circuit at their disposal that allows them to use only roughly matched diodes to achieve tracking between the tuner's several tuned circuits. Further, a TV tuner using the new device needs virtually no align-

ment during set production.

The IC, now in its final stages of development at Intermetall GmbH, the lead house of the ITT Semiconductors group, uses a proprietary technology that permits on-chip digital-to-analog converters with 2- μ m structures and generates tuning voltages as high as 30 V.

Currently, tuner production is slowed by the need for capacitance, or tuner, diodes—usually three, but sometimes four per set—each with a capacitance value deviating by no more than 1.5% to 2% from that of the others. But to get such closely matched samples, diode makers must test hundreds of thousands of devices before they have a batch of 1,000-odd diodes with the required minimum deviation.

Even with automation, that takes

time and adds to diode costs. Worse, with limited numbers of diodes, set makers find that automated continuous device-insertion techniques are impractical. That, in turn, raises the tuner costs further.

Mass movement. Here is where Intermetall's new IC comes in. With the UAA2920 tuner-alignment IC, TV producers can use three or four diodes in their tuners whose capacitances vary by 10% or more from each other. Given this tolerance spread, diode makers can measure, select, and put on tape and reel large numbers of diodes—into the tens of thousands—in one run.

Diode makers will benefit because they can now deliver large numbers of diodes on shorter notice. (Intermetall itself is a big tuner-diode producer—the world's biggest, it says,

claiming more than half the West German and nearly a third of the world's market for such devices). Set makers will benefit not only from the lower diode costs, but also because, with large quantities of diodes per batch, automated and continuous insertion techniques will lower tuner production costs.

Just how much set makers can speed up tuner production or save on costs, Rolf Deubert, Intermetall's project manager, cannot say. "But even considering the cost of the integrated circuit we are going to offer, TV makers will come out ahead because they can now exploit automated insertion techniques to the fullest."

The chip uses Intermetall's proprietary collector-implanted technology. Although the firm is reluctant to give details about it, it is essentially a bipolar technology that produces the collector structures by implantation methods. It lends itself to fabricating circuits for high frequencies—well into the gigahertz range—and produces structures of 2 μ m or less, comparable to those obtainable with MOS techniques.

Handy designing. While the high frequency advantage of the CI technology is of little significance in the tuner application, its small-structure capability comes in handy in designing precise on-chip digital-to-analog converters. These generate up to 30-V outputs required for biasing the tuner diodes. This bias, in turn, brings the TV receiver's preselection circuits and band filters to the required frequencies.

The UAA2920, to be available in an 18-pin plastic package later this year [*Electronics*, July 12, 1984, p. 63], packs four d-a converters with 9-bit resolution, reference-current sources for these converters, three output amplifiers, and a comparator, all on a 7.5-mm² chip. Data transfer between the chip's various parts is through the IM (for Intermetall) bus.

The chip operates in conjunction with a microprocessor, which determines the digital values required for the tuning voltages. Such a proces-

Tuned in. Rolf Deubert, Intermetall's project manager, says that despite the added cost of his tuner-alignment IC, "TV makers will come out ahead because they can now exploit automated insertion techniques."



sor—it can be any type on the market—is common in European-made TV sets for handling the signals for infrared-remote control, phase-locked loop, and other functions, and is finding increasing use in U.S. sets, according to Deubert.

The system works as follows: first, the viewer's selection of a station or channel sets the bias of the tuner oscillator's tuner diode. This is done by the set's voltage synthesizer or

frequency synthesizer. Then, the bias of the other tuner diodes (those that tune the preselection circuit and the band filter) is adjusted digitally to maximum response by the chip's d-a converters.

Because this is done separately for each diode, their capacitance values need not be closely matched. Thus, not only do the capacitance deviations of the tuning diodes become irrelevant, but likewise all tolerances

of the components in the associated resonance circuits. This obviates the need for complicated tuner alignment procedures during tuning production.

It is possible to use a memory that would store the digital word for each converter and channel. In this case, the stepwise approximation of the diodes' bias will not be necessary when a channel is selected. The approximate bias would be derived from the memory.

—John Gosch

EXPERT SYSTEMS

Lisp machine provides a shell for industrial AI applications in one of first expert systems to go to work

Austin, Texas—Expert-system technology is taking its first cautious steps out of the development laboratory and into the industrial world of process control. One of the first products to put its knowledge base to work in a U.S. plant will be a real-time expert system from Lisp Machine Inc., Los Angeles.

Picon, for process intelligent control, made its official debut at the National Conference on Artificial Intelligence here this month and is slated to enter beta testing in the fourth quarter. It uses a 16-bit Motorola Inc. 68010 microprocessor, AT&T Bell Laboratories' Unix software, and Multibus or Ethernet-II interfaces to link expert-system software to existing industrial controllers.

Human-like. Many mainframe-based controllers can monitor up to 20,000 measurements and alarms. The system pays particular attention to trouble spots, but it will continue to monitor up to 20,000 points in a background mode—much like a human operator.

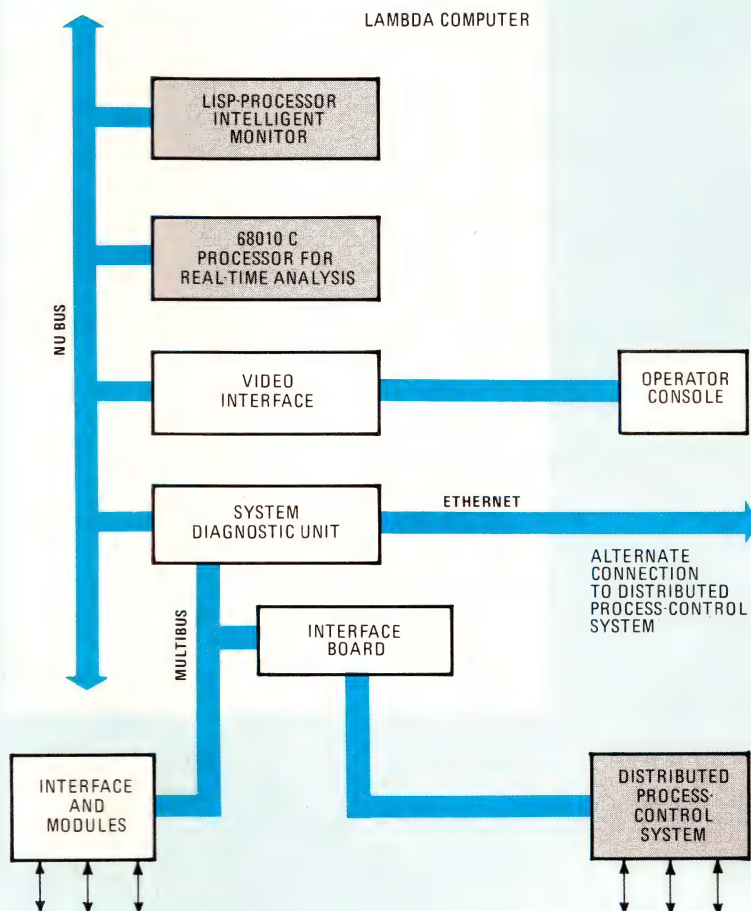
The 68010 inside Lisp Machine's Lambda/Plus system preprocesses data from the controller host, reformatting information for the 32-bit Lisp inferencing engine. The microprocessor, which also performs some

inferencing algorithms of its own, uses the Lisp-based machine as a batch-mode 32-bit processor.

Picon, which sells for between \$150,000 and \$200,000, will be used

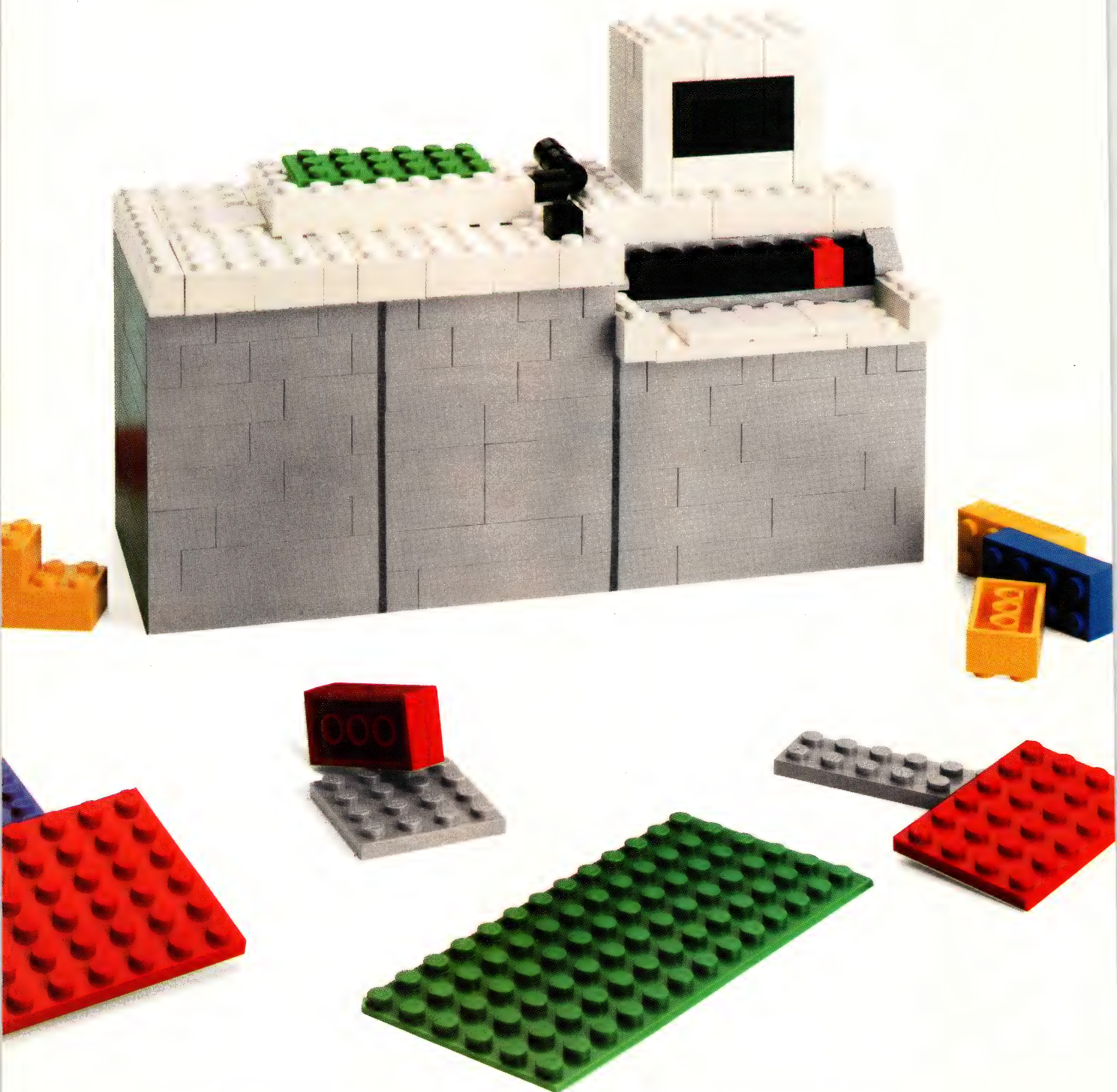
on its first industrial job in an oil refinery on the Texas Gulf later this year, according to Frank R. Spitznogle, president of Lisp Machine.

Designed to allow users to create



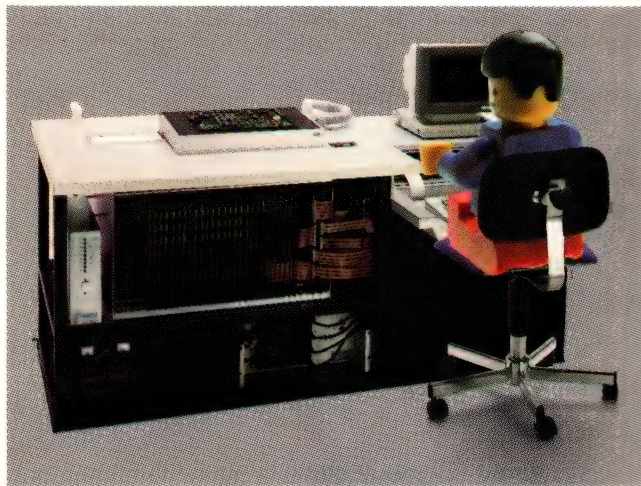
intelligently monitor as many as 20,000 points in a process-control system. The system can reprogram its monitoring patterns on the fly to adjust to trouble spots.

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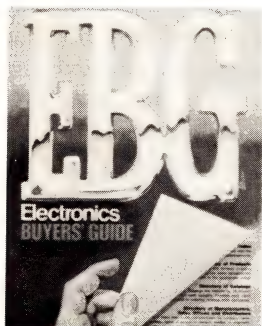


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Lisp-based expert systems without knowing the AI programming language, the Picon package uses a knowledge-data-base shell, which is filled in by the operator. Working with the aid of interactive graphics, icons, and a menu system, users first build a visual representation of the process flow.

Next, rule-capture software is used to enter operational parameters. Knowledge from experienced human operators is also placed in the data base, along with relationships between critical variables.

Realistic expectations. "Expert systems are useful today in very narrow fields and can be almost as good as a human expert," says Spitznogle. "One thing we are trying to do is play down some of the recent fanfare artificial intelligence has been getting. We don't want some of the wild enthusiasm that soured in the robotics markets."

Picon's expert system is intended as an intelligent alarm advisor, mak-

ing humans better operators. It carries on a dialogue with the host process controller, reprogramming its monitoring patterns on the fly to focus on surfacing trouble spots.

"You don't want to close loops, however," warns Spitznogle. "It's like a new operator, and you would not let a new human operator close loops in processing on his first day. Picon will have to learn over two or three years, just like a new operator." As time goes on, it will be possible for human operators to expand the system with new rules and areas of knowledge, the executive points out.

The firm will take the same shell expert system strategy into other markets, says Spitznogle. Next is the aerospace industry, where Lisp computers will initially aid in electrical-fault diagnostics. Eventually, Spitznogle anticipates that applications-oriented expert-system packages will account for some 30% to 40% of his firm's business. —J. Robert Lineback

ENTERTAINMENT

West German juke box adds video by employing laser-disk technology

Hüllhorst, West Germany—At first glance, it looks pretty much like a traditional juke box: a row of records and a playback unit in a glass cabinet. But drop a coin into the slot and pick a title, and out comes not only sound, but also moving pictures, displayed on a nearby television screen.

As its name implies, the Lasergraph, from Deutsche Wurlitzer GmbH, in this small Westphalian town, plays laser disks. It draws heavily on existing technology: The disks and playback unit are well-established products pioneered by Philips, in Eindhoven, the Netherlands, a dozen years ago. The intelligent record-changer mechanisms come from Wurlitzer's own expertise as a music box maker.

The Lasergraph will first turn up in bars, restaurants, and discos in West Germany. But Wurlitzer, a subsidiary of the famed U.S. manufacturer of organs and other key-

board instruments, in De Kalb, Ill., has its sights set on a potentially far bigger market.

"What we are really after are sales to schools and other training institutes, hobby marts, and supermarkets," says Norbert Lohre, a Wurlitzer executive. The Lasergraph—without coin operation—would be used to show how-to and training programs or present product announcements to shoppers.

The present Lasergraph entertainment version has 15 laser disks in its repertoire, but future systems will have up to 20 disks. Each 30-cm disk has one hour of video-sound programs per side. Each side is divided into as many as 23 program titles, with a selection code at the beginning of each title.

The system's entertainment version uses commercially available laser disks. For training, product announcements, and other applications,

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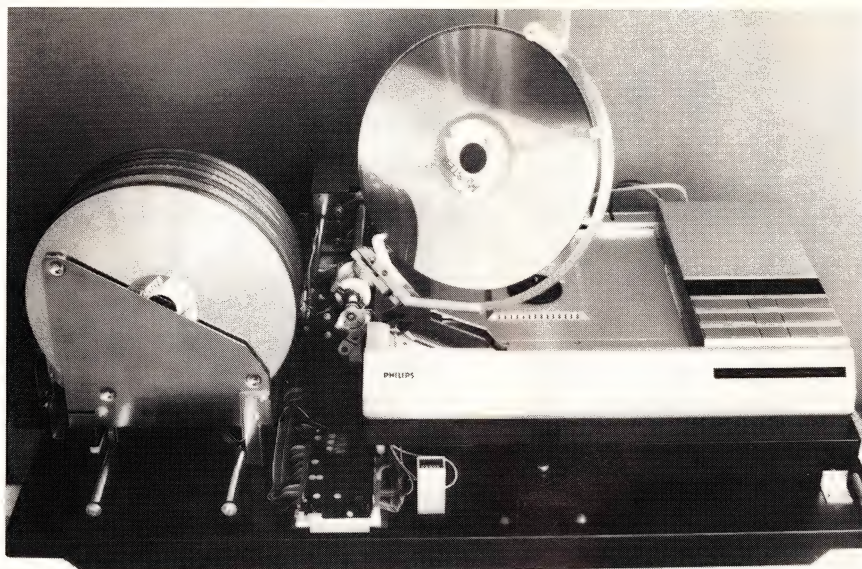
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Gee, Dad, it's a Wurlitzer. Laser juke box combines Wurlitzer-developed intelligent record-changer mechanisms and laser-disk playback units developed by Philips.

custom disks must be made. The advantages of the Philips disks are that they deliver high-quality pictures and sound, and are wear-resistant.

In a coin-operated system, the user would pick a title at a remote selection box. For commercial applications, Wurlitzer will offer an infrared-based remote control device with which the operator would select a program on a hand-held transmitter unit.

It takes up to 20 s for the Lasergraph to look for a specific disk, pick it from its slot, place it in the playback unit, and for the unit to get up to its playing speed of 1,500 rpm. Another few seconds are needed for the system to look for a specific title on the disk.

A seven-segment character display shows the title selected and how many titles the user has to his or her credit after the coin is inserted. It also indicates possible system malfunctions. For sound and picture reproduction, any TV set on the market can be used, Wurlitzer says. Wurlitzer is not the only firm with the video-and-sound-box idea. At least one Japanese company, Pioneer, and one small American company are developing such systems and have unveiled prototypes. But the German firm believes it has a head start in getting units to market. Deliveries will start shortly.

Lasergraph systems will be shown in the U.S. at the Amusement and Music Operators Association's exhibi-

tion in Chicago this October. The production target for the rest of this year is for between 100 and 200 systems, and for 1985, between 500 and 1,000. On the German market, the basic Lasergraph system, consisting of the playback unit and the changer mechanism, will sell for about \$1,430.

—John Gosch

DATA TRANSFER

System handles incompatible files

Stamford, Conn.—Current document-transfer systems can give users a headache. The problem is that the receiving system can read, print, or add to a file only when it has been encoded in the same way as the system sending the file. Thus the file cannot be edited unless it is reformatted in a manner compatible with the receiver's computer.

In October, Telentry Systems Inc. will beta-test a system that includes a document-encryption process applied during transmission and can send documents of virtually any length to an incompatible computer, where the receiver can edit them immediately. The service's critical aspect is its software translation language, which runs on a Digital Equipment Corp.

VAX 750 minicomputer located in Stamford.

"It's an all-software solution to translation," says Telentry's president, James Gershman. "For example, we can take codes that come to the central node in soft carriage return and translate them into hard carriage form."

But Stephan Glasgow, a consultant with Walter Ulrich Consulting Inc., Houston, is cautious. "They could have trouble dealing with certain commands and might have to strip them away—including important features like double underlines in some law documents."

Intelligent interface. Telentry says it will initially offer the service for users of word processors and many IBM Corp. and Wang Laboratories Inc. computers. It will supply its customers with a product called the DataDriver, which interfaces with the central node to transmit and receive documents.

The intelligent DataDriver plugs into computers and can store up to 1,000 pages in nonvolatile memory. It can operate unattended, sounding a beep when a document is delivered. The unit, along with training and maintenance, will be provided free of charge; the sender will pay a per-page rate ranging from 30¢ for overnight delivery to \$1 for 30-min delivery.

For the beta test, Telentry enlisted some 400 customers. "We're sifting through thousands of additional companies that want to be in the beta test," says Gershman.

Telentry has raised \$10 million through research and development partnerships funded by various sources, including insurance companies, banks, and private investors, and the company has leased R&D equipment. It has paid General Electric Professional Services Co. hundreds of thousands of dollars to act as a consultant, according to Gershman. In January, when the firm plans to offer the service nationwide, TRW Inc., Cleveland, will take over installation and maintenance.

Amy Wohl, president of Office Concepts Corp., Bala Cynwyd, Pa., also expresses interest in the plan, but predicts that it will take a while to make money. Gershman, however, expects profits by the second quarter of 1985.

—Steve Haggerty

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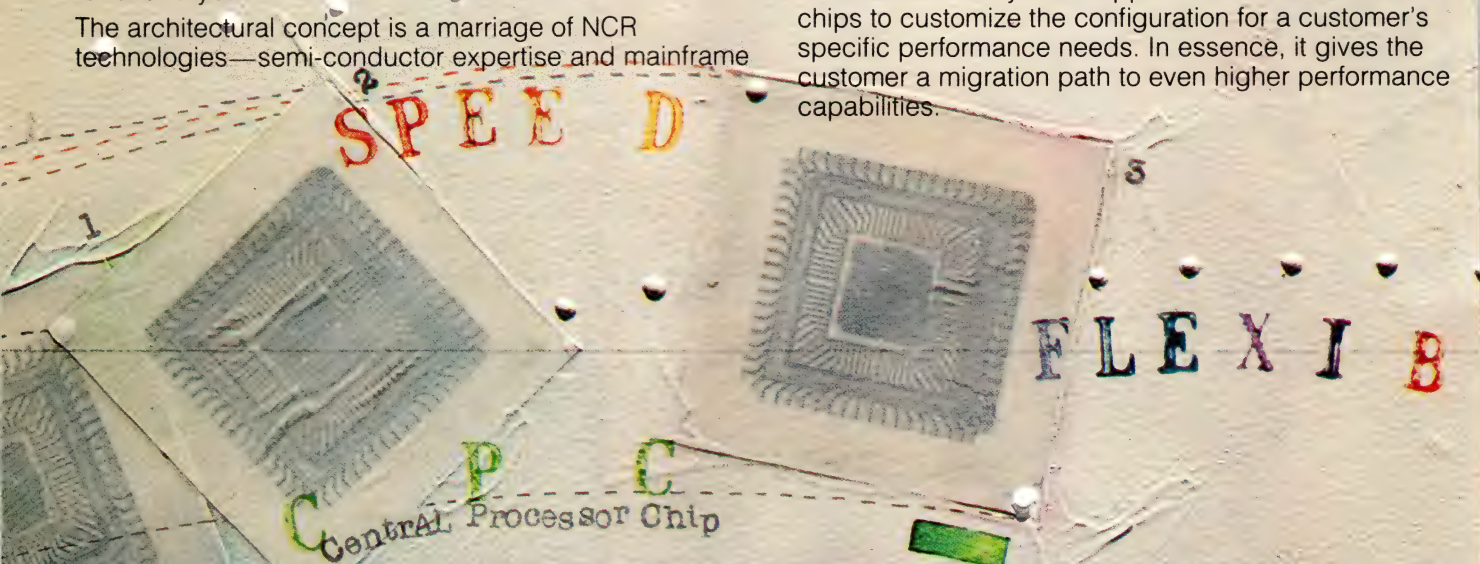
The NCR/32 Processor Family

The NCR/32 processor family represents a breakthrough in the evolution of VLSI technology. It is the "next generation" in systems design and the only true 32-bit solution that has been available in production quantities for over a year.

The architectural concept is a marriage of NCR technologies—semi-conductor expertise and mainframe

How The Family Is Related

The NCR/32 family consists of the Central Processor Chip (CPC), the Address Translation Chip (ATC), the System Interface Controller, Transmitter, and Receiver (SIC, SIT, SIR), and a "booster" Extended Arithmetic Chip (EAC). The NCR/32 family also supports the addition of other chips to customize the configuration for a customer's specific performance needs. In essence, it gives the customer a migration path to even higher performance capabilities.



computer design knowledge. The result of this is an externally microprogrammable 32-bit system that is flexible, can perform with extreme speed, can emulate mid-range mainframes, has comprehensive memory management, and high performance floating point and decimal arithmetic.

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System Performance— Flexibility	
• System modification easier and less costly • Tailored applications are created faster than with custom silicon design	• Can support either emulation or direct execution

A customer sampling the chipset in a medical system remarked "...the NCR/32 should be taken very seriously by anyone creating a product that requires high performance."

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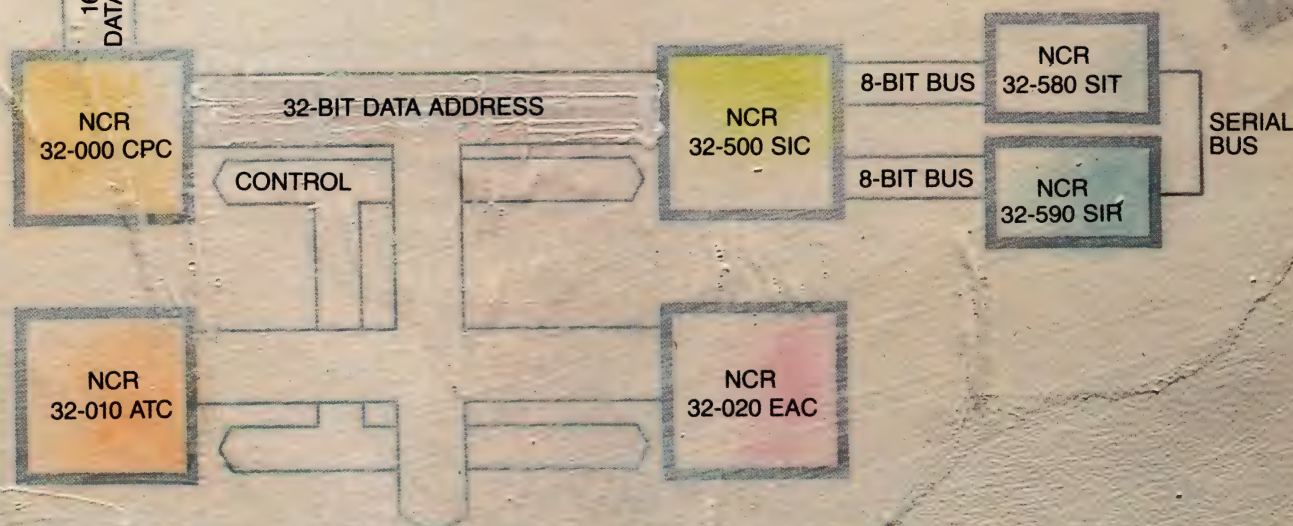
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*Source: Data Quest April 1983 and February 28, 1984.

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+5 Volt only operation and Commercial Operating Temperature (0°C-70°C) is standard for all NCR ROMs.

Function	Part Number	Max. Current Active	(mA) Standby	Access Time Max (ns)	No. of Pins	Pin Compatible EPROM
16K ROM	NCR 2316	80	—	300/450	24	2716
32K ROM	NCR 2332	80	—	300/450	24	2532
	NCR 2333	80	—	300/450	24	2732
64K ROM	NCR 2364	85	—	250/300/450	24	2564
	NCR 23C64	25	0.01	250	24	2564
	NCR 2364A*	85	—	450	24	Bank Select
	NCR 2365	85	—	250/300/450	28	2764
	NCR 23C65	25	0.01	250	28	2764
128K ROM	NCR 23128	75	—	250/300/450	28	27128
	NCR 23128S	75	10	250/300/450	28	27128
	NCR 23128A*	110	—	450	24	Bank Select
256K ROM	NCR 23256	95	—	200/250/300/450	28	27256
	NCR 23256S	95	10	200/250/300/450	28	27256
	NCR 23257	95	—	200/250/300/450	28	JEDEC alt.
	NCR 23257S	95	10	200/250/300/450	28	JEDEC alt.

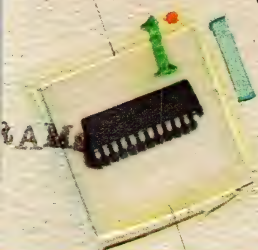
*Licensed under U.S. Patent Number 4368515.

Memory

Why We're First, Not Second

NCR holds most of the original patents for non-volatile RAMs—dating back to 1973. Our first device came to market in 1976, two years before our only competitor in nibble-wide nonvolatile RAMs became a company. Today, we offer the broadest line of nonvolatile random access memories in low and high densities, and both nibble-wide and byte-wide organizations in production quantities.

The NCR NVRAM brings with it some important exclusives. We guarantee one year retention with 10,000 store cycles. We offer memory margining—an objective method of measuring retention time. Our 10,000 bit change part is standard, not premium. NCR's retention endurance specs are unsurpassed. Our NVRAM's are available in quantity as an off-the-shelf distributor component, and since there are second source equivalents to almost all of our NVRAM devices, there's absolutely no reason not to consider NCR first.



NVRAMs

+ 5 Volt only operation and all NVRAMs are available in commercial, industrial and military temperature ranges.

Function	Part Number	Organization	Access Time Max (ns)	No. of Pins	Equivalent
256 Bit NVRAM	NCR 52210	64x4	300/450	18	x2210
512 Bit NVRAM	NCR 52211	128x4	300/450	18	—
1K NVRAM	NCR 52212	256x4	300/450	18	x2212
1K NVRAM	NCR 52001	128x8	300/450	24	—
2K NVRAM	NCR 52002	256x8	300/450	24	—
4K NVRAM*	NCR 52004	512x8	300/450	24	—
4K NVRAM*	NCR 52004-28	512x8	300/450	28	2004-x2004

*Sample available August 1984.

How EEPROMs Help Us Hold The Lead

NCR holds the leadership position in Electrically Erasable Programmable Read Only Memories, too. In fact, we offer the broadest line on the market. Our endurance retention specs of 10K cycles, 10 years, 100% tested are guaranteed and, of course, we offer memory margining. Our low density NCR 59306 (256 bit) is a second source to the 9306 E², but we go one step further. Our 59308 is

the first serial 1K part available in volume, and it too, is pin compatible with the 9306 but twice as fast.

In high density EEPROMs, NCR is the only supplier of 32K parts in volume. Our 52832 already has design-wins in military applications. Currently, we're sampling our 64K device. Both parts have flexible erase/write times, and active current for both is specified at 60 mA over the full military temperature range.



EEPROMs

+ 5 Volt only operation

Function	Part Number	Organization	Access Time Max (ns)	No. of Pins	Temperature Range
256 Bit EEPROM	NCR 52801	16x16 (Serial)	125 kHz	14	COM, IND.
	NCR 59306	16x16 (Serial)	500 kHz	8	COM, IND.
1K EEPROM	NCR 59308	64x16 (Serial)	500 kHz	8	COM, IND.
32K EEPROM	NCR 52832	4Kx8 (Parallel)	300	28/32*	COM, IND, MIL
64K EEPROM	NCR 52864	8Kx8 (Parallel)	350/450	28/32*	MIL

*28 Pin DIP or 32 Pin LCC. (Both ceramic)

The NCR Commitment And You

Over the years, we learned about user application problems, the importance of quality components and reliability of memory products when we developed and fabricated these products for ourselves. We've learned about the importance of keeping firm delivery promises to you. Since we introduced our ROMs, NVRAMs and EEPROMs outside of NCR, we have gained acceptance as a quality supplier.

What does "NCR Commitment" mean? It means that top-notch levels of quality, reliability and delivery are the standard for every NCR memory product. We earned the respect of NCR long ago. We have earned the respect of our present customers. Now we want to earn yours.

For more information on NCR Microelectronics Division Memory Products, please call: **1-800-543-5618**

or 1-513-866-7217 (in Ohio).

We've been there.

You can expect it from NCR.

Circle 43 on reader service card

3.

What We Can Do With Our Library And Your Idea

NCR Standard Cell Design Services

With our standard cell library and your idea, we can design, develop, fabricate and test the semicustom solution you need. We can cut your lead time to market. We can reduce your development costs. We promise security of your design. We can provide you with system enhancement and system reliability. We guarantee delivery.

Committed To The Systems Approach

The NCR Semicustom approach is a systems approach with full commitment to finding appropriate customer solutions. Engineers at our local, fully staffed Design Centers or at our Fort Collins facility evaluate all designs, assess the feasibility of a standard cell solution and analyze your logic. They look for the optimum design.

At the same time, they provide cost estimates you can rely on which include all expenditures that relate to the cost of your project—all before you commit to it.

1. Best semicustom approach
2. Engineering costs
3. Prototype lead time
4. Production lead time
5. Production cost

Flexibility Of Project Control And Responsibility

Another key factor in the NCR Semicustom approach is flexibility of project control. NCR engineers will assume total control and design responsibility if you want them to. However, if you prefer to maintain control over your own project, go ahead. You can use your own engineering workstation in your own facility or come use ours to do your entire design yourself. NCR provides training and complete applications support in all of its design centers.

NCR CAD Support

We fully support your design on Daisy™ or Mentor Graphics™ engineering workstations in completely equipped CAD tool Design Centers both inhouse and nationwide. Our customers are provided with total CAD capability through NCR proprietary timing analysis and test generation programs which supplement software provided with the engineering workstation. NCR is committed to continuing the advancement of CAD tool technology.

The Lead Time Factor

One of the ways we cut costs is by saving time. With our standard cell library, our systems approach and our commitment to service, we can provide you with dramatically reduced lead times.

1. Design and development (3000 gate complexity) 6 to 10 weeks
2. Mask and prototype fabrication . premium 4 to 6 weeks
standard 6 to 8 weeks
3. Prototype Approval and Production
lead time 6 to 10 weeks

Semicustom Service

The heart and soul of NCR Semicustom Design is service. When you come to NCR, you are assured of a successful program and total service from design inception to production of your parts. Our repeat customers and those who have switched to NCR will attest to the completeness of our semicustom service.

The NCR CMOS II Standard Cell Library

The NCR CMOS II Standard Cell Library plugged into NCR's advanced computer-aided-design (CAD) tools provide cost efficiency and high performance. The variety of cells including "supercells" allows for optimization of your system and silicon area. This means better performance and lower cost. Other key features include:

- 3-micron CMOS Cell Library
- Core 65CX02 microprocessor "supercell"
- Optional RAM, ROM, PLA
- Analog up to 8-bit A/D complexity
- 5V Power supply; directly TTL compatible
- Advanced CAD System with workstations and engineering support
- Complete selection of packaging options

CMOS II Digital Cell Library Offerings

- A broad selection of functions, including but not limited to the following:
 - SSI functions—buffers/inverters, NAND/NOR, AND/OR, Combination Logic
 - Flip Flops/latches—S-R flip flops, DFFs, JKFFs
 - MSI functions—Cascadeable multiplexer, shift register, up/down counter
 - I/O Pads and Buffers—Standard drive, high drive, open drain, tri-state

NCR CUSTOMER



Injection Testing



MOS II Analog Cell Library Offerings

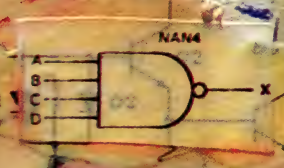
- Op Amp
- Comparators
- Analog Switch
- Bandgap Voltage References
- Expandable Oscillators
- 3-bit DAC, 4-bit DAC
- 3-bit A/D, 6-bit A/D
- Negative Supply generation, -5V for a total 10V swing
- Bias Generators
- Logic Level Shifter
- Power-On Reset—guaranteed to reset the circuit on power-on
- Sound Generator

Semicustom Quality Assurance

Our primary goal is to meet or exceed your quality and reliability requirements. Each process and product is extensively characterized and qualified. Standard Cell designers, Computer Aided Design Engineers, Application Engineers and Quality Assurance Engineers all work together toward first pass design success for all standard cell customers.

Each cell has been subjected to the same rigorous testing used to qualify standard parts. After initial qualification, the Quality Assurance Department samples production parts and performs ongoing reliability testing to maintain the highest levels of confidence in fabrication and assembly operations. Prior to shipment, each production part receives 100% testing and visual inspection.

Give the NCR Semicustom team a chance to prove to you that we are committed to your interests. We are on our team. We do what we promise and more, everytime, with no exceptions.

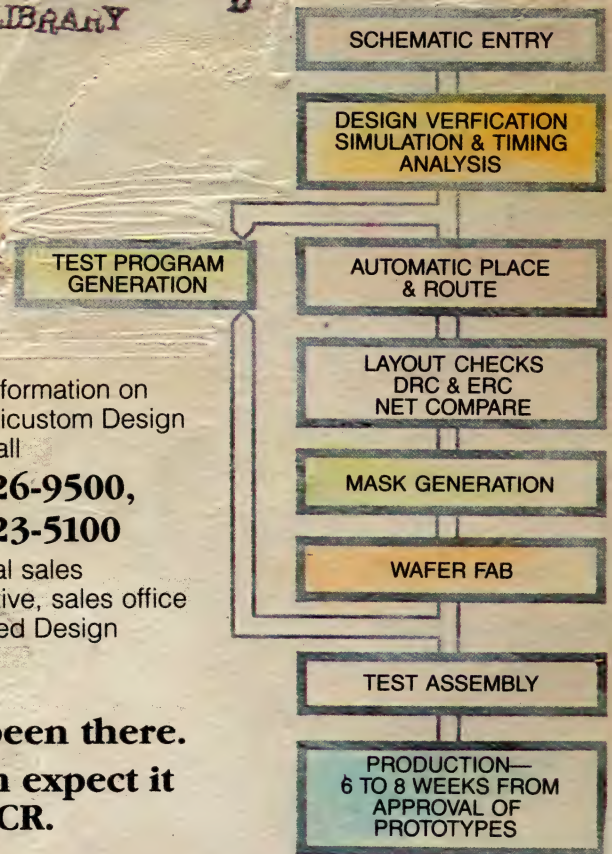


DUE ON LAST DATE STAMPED BELOW

SEP 28 1983
OCT 21 1983
NOV 13 1983
DEC 17 1983
DEC 18 1983
JAN 9 1984

PORT COLLINS STANDARD CELL LIBRARY

SEMICUSTOM PROGRAM



For more information on NCR's Semicustom Design services, call

1-303-226-9500,
1-303-223-5100

or your local sales representative, sales office or contracted Design Center.

We've been there.
You can expect it
from NCR.

4.

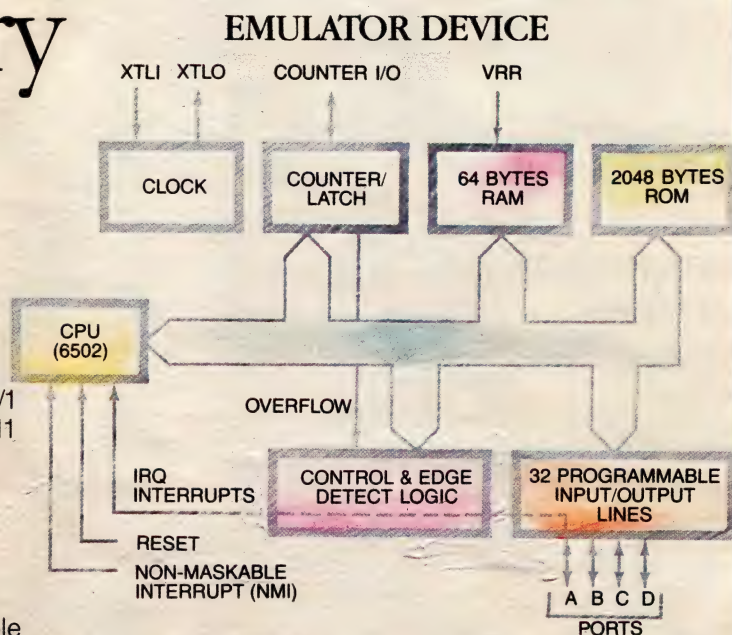
Why "Allocation" Is Not In Our Vocabulary

The NCR 6500 Family Of 8-bit Microcomputers

The last thing you want to hear when ordering in volume is that your need cannot be met. That's why "allocation" is not in our vocabulary when we're talking about 8-bit single chip microcomputers. The NCR 6500/1 has been in production for over a year. The NCR 6500/11 is ready for design-in and, the CMOS version of the 6500/1 (6500C/1) will be ready by year-end. If you need them, NCR has them.

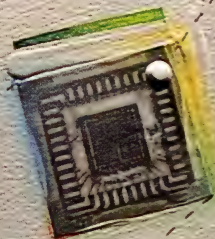
The NCR 6500/1

The NCR 6500/1 is a complete, high-performance 8-bit microcomputer on a single chip. It is software compatible with all members of the 6502 and 6500 families. The 6500/1 consists of a 6502 CPU, an internal clock oscillator, 2048 bytes of ROM, 64 bytes of RAM and versatile interface circuitry. The interface includes a 16-bit programmable counter/latch, 32 bidirectional I/O lines (including 2 edge-sensitive lines), 5 interrupts and 1 counter I/O line.



Single-chip Microcomputer Product Details

- 6502 CPU
 - 8-bit parallel processing
 - Software upward compatibility
 - 13 addressing modes
 - Decimal or binary arithmetic
 - True indexing capability
 - Memory addressable I/O
 - Pipeline architecture
- 2048 x 8 mask-programmable ROM
- 64 x 8 static RAM
- Power down mode
- 32 bidirectional TTL compatible I/O lines (1 positive and 1 negative edge-sensitive)
- 1 bidirectional TTL compatible counter I/O line
- 16-bit programmable counter/latch
 - Interval timer
 - Pulse generator
 - Event counter
 - Pulse width measurement
- Five interrupts: 4 external and 1 counter overflow
- 6 MHz max crystal or external clock frequency
- 1 or 3 MHz internal clock
- 70% of instructions have execution times less than 2 μ s at 2 MHz
- NMOS silicon gate, depletion load technology
- Single +5V power supply
- Emulator device available





If you need them

हम भी उस मार्ग पर चले हैं।

al-lo-ca-tion (al-o'kashən) *n.* -s allocation-, allocatio, fr. al-locatus + -ion, -ion, -ion) 1 archaic: the action of putting or adding one thing to another. 2 the action of apportioning: apportionment for specific purposes or to particular persons or organizations as a control measure—common to many semiconductor manufacturers with the notable exception of the NCR Microelectronics Division...

Device Operation Details

Central Processing Unit (CPU)

The CPU in the NCR 6500/1 is a standard 6500 configuration including all 6502 instructions. All instructions are executed in 2 to 7 clock cycles. The automatic increment/decrement feature of the stack pointer facilitates rapid and flexible subroutine execution and interrupt servicing, including context switching. Two 8-bit index registers permit pre- and post-indexing of indirect addresses.

Read Only Memory (ROM)

The ROM for the NCR 6500/1 consists of 2048 by 8-bits of mask-programmable memory with an address space from 800 to FFF.

Clock Oscillator

The clock oscillator provides the basic timing signals used by the CPU. The reference frequency is provided by an external source, and can be from a crystal or RC network input. The RC network mode is a mask option. The external frequency can vary from 200 KHz to 6MHz. The internal Phase 2 (Ø2) frequency is one-half the external reference frequency. A 4.7K ohm resistor will provide nominal 2 MHz oscillation and 1 MHz internal operation in the RC mask option ($\pm 35\%$).

Bidirectional I/O Ports

The NCR 6500/1 provides four 8-bit I/O ports (PA, PB, PC and PD). Associated with the I/O ports are four 8-bit registers located on page zero. Each I/O line is individually selectable as input or an output.

Counter/Latch

The counter/latch consists of a 16-bit decrementing counter and a 16-bit latch. The counter and the latch are each composed of two 8-bit registers. The counter operates in any of four modes: Interval Timer; Pulse Generator; Event Counter; or Pulse Width Measurement.

The 8-bit Solution

NCR offers the definitive 8-bit solution. No other manufacturer can match NCR's service, prototype development, fast turnaround and high volume capability. Furthermore, when it comes to production, we offer improvements as well as cost advantages. NCR knows what it takes.

For more information on the NCR 8-bit microcomputer, call **1-800-525-2252**

We've been there.

You can expect it from NCR.

5.

How We Connected With a



NCR SCSI Protocol Controller (SPC)

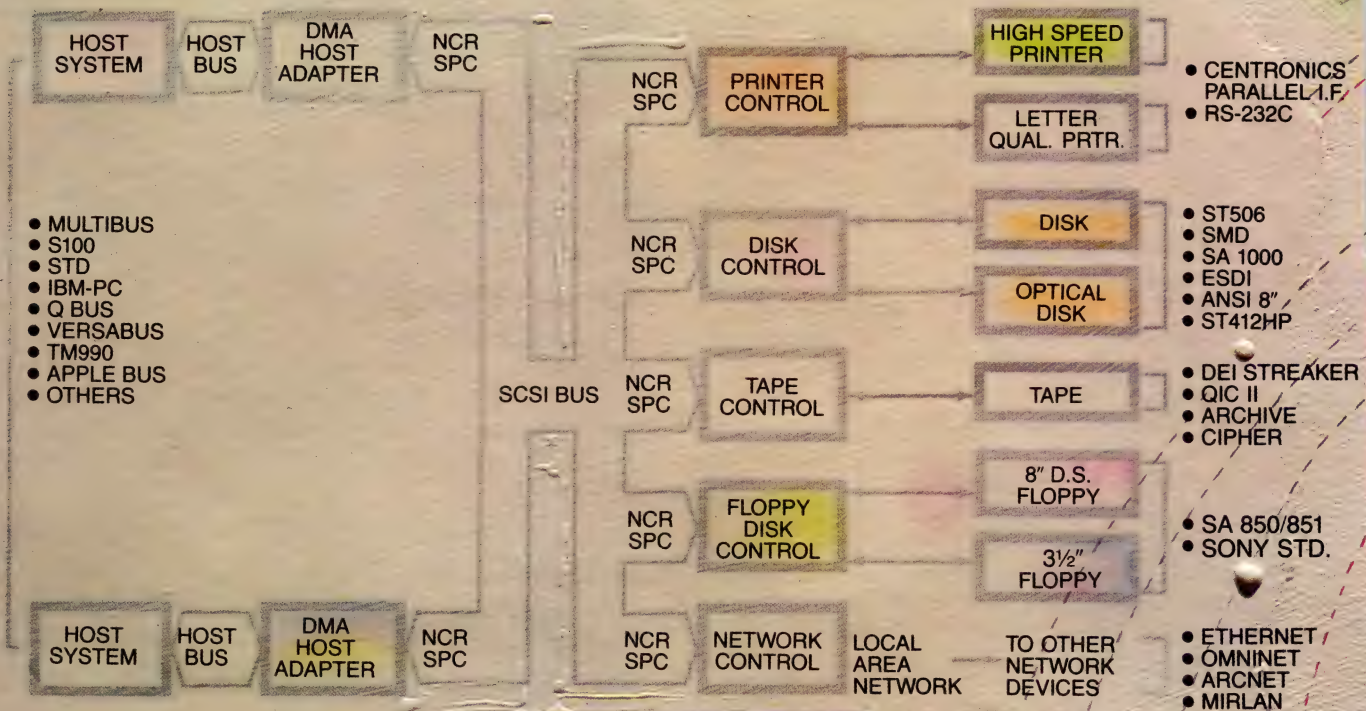
Standardization of computer components and peripherals interconnection is fast becoming a reality. Ideally, interfacing computer components will be as simple as connecting a stereo system. A sound idea.

The NCR SCSI Protocol Controller (SPC) is the only single chip Small Computer Systems Interface controller on the market. As a proposed standard, the SCSI protocol controller has already been widely accepted in the industry and encourages plug compatibility between hosts and peripherals regardless of manufacturer.

Since plug compatibility is not yet standard, there exists a true need for the NCR SCSI Protocol Controller Chip. It can exercise protocol control on all signals on the SCSI bus from host to peripheral and peripheral to host. Essentially, it polices the flow of signals or information over the byte-wide bus by a system of priority arbitration. The NCR SPC can be installed by manufacturers who need plug compatible products in order to stay competitive in the marketplace.

The NCR SPC Protocol Controller is truly a standard product now available in production quantity.

NCR SCSI PROTOCOL CONTROLLER BUS



ound Idea

Key Facts and Features

- Supports ANSI x3T9.2 SCSI Proposed Standard
- Asynchronous data transfers to 1.5 MBytes/Sec
- Supports Initiator and Target Roles
- Odd parity generation with optional parity checking
- Supports arbitration (multiple hosts and concurrent I/O operations)
- Controls all bus signals except bus reset
- 2. Versatile microprocessor bus interface

- DMA or programmed I/O transfers
- Internal transfer counter (24 bits)
- Programmable selection and reselection timeouts (multiple of 1024 clock periods)
- Interrupts processor when SCSI bus requires service
- 3. 48 pin DIP

Key Benefits

Reliability—only monolithic solution to full SCSI Protocol control.

Flexibility—can be used with any SCSI device unit design.

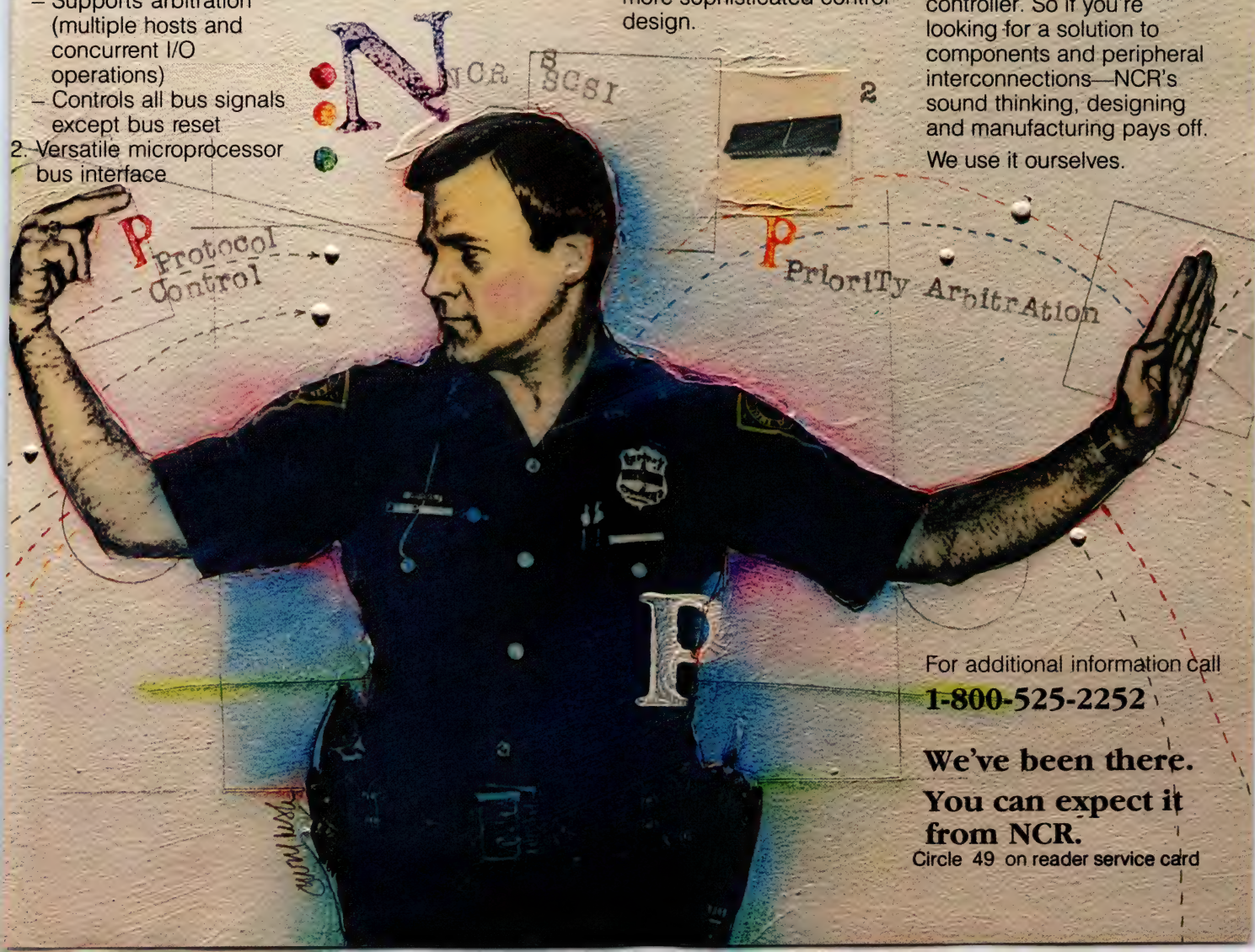
Quick Design-In—readily maps into existing controller design.

Reduces Board

Size—fewer chips allow for more sophisticated control design.

Sound Thinking Pays Off.

The key to competitive strategies in today's market is to stay ahead of everyone else. With the SCSI Protocol Controller, the task is made considerably easier. The benefits listed above clearly point out the advantages of the NCR Small Computer Systems Interface controller. So if you're looking for a solution to components and peripheral interconnections—NCR's sound thinking, designing and manufacturing pays off. We use it ourselves.



For additional information call
1-800-525-2252

**We've been there.
You can expect it
from NCR.**

Circle 49 on reader service card

What We Do To Address Your Needs

We learned the disciplines of quality, reliability, teamwork and service as a captive NCR supplier. Today, these qualities are more than tradition at NCR. They're standard practice.

From the design of semicustom devices using a standard cell system developed with NCR systems engineers to high volume ROMs or microcomputers—cooperation, service and integrity are all value added features you can expect from NCR Microelectronics.

Our technology speaks for itself. It produced the first commercially available 32 bit processor which we've been shipping in volume for over a year. This rich technical base is behind each NCR Microelectronic product.

Service, cooperation, integrity and technology. These qualities are as important to us as they are to you. We have walked in your shoes.



1. How Innovative Architecture Runs In The Family

For information concerning the NCR/32-000 chipset, the 8-bit Microcomputer, or the SCSI Protocol Controller, please call or write to:

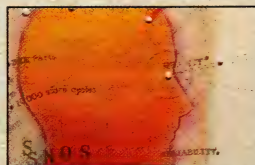
The Marketing Department
NCR Microelectronics
Division
1635 Aero Plaza Drive
Colorado Springs, CO
80916
1-800-525-2252
596-5612 (Colorado
Only)
TELEX: 45-2457
NCR MICRO CSP



4. Why Allocation Is Not In Our Vocabulary



5. How We Connected With A Sound Idea



2. Why We're Committed to Memory

For information concerning the NCR memory products, please call or write to:

The Marketing Department
NCR Microelectronics
Division
8181 Byers Road
Miamisburg, Ohio 45342
1-800-543-5618
1-513-866-7217 (Ohio
or International)
TELEX: 24-1669
NCR NVMEM MSBG



3. What We Can Do With Our Library and Your Idea

For information concerning NCR Semicustom Design Services and capabilities, please call or write to:

The Marketing Department
NCR Microelectronics
Division
2001 Danfield Court
Fort Collins, Colorado
80525
1-303-266-9500
TELEX: 45-4505
NCR MICRO FTCN

**We've been there.
You can expect it
from NCR.**

NCR
Microelectronics

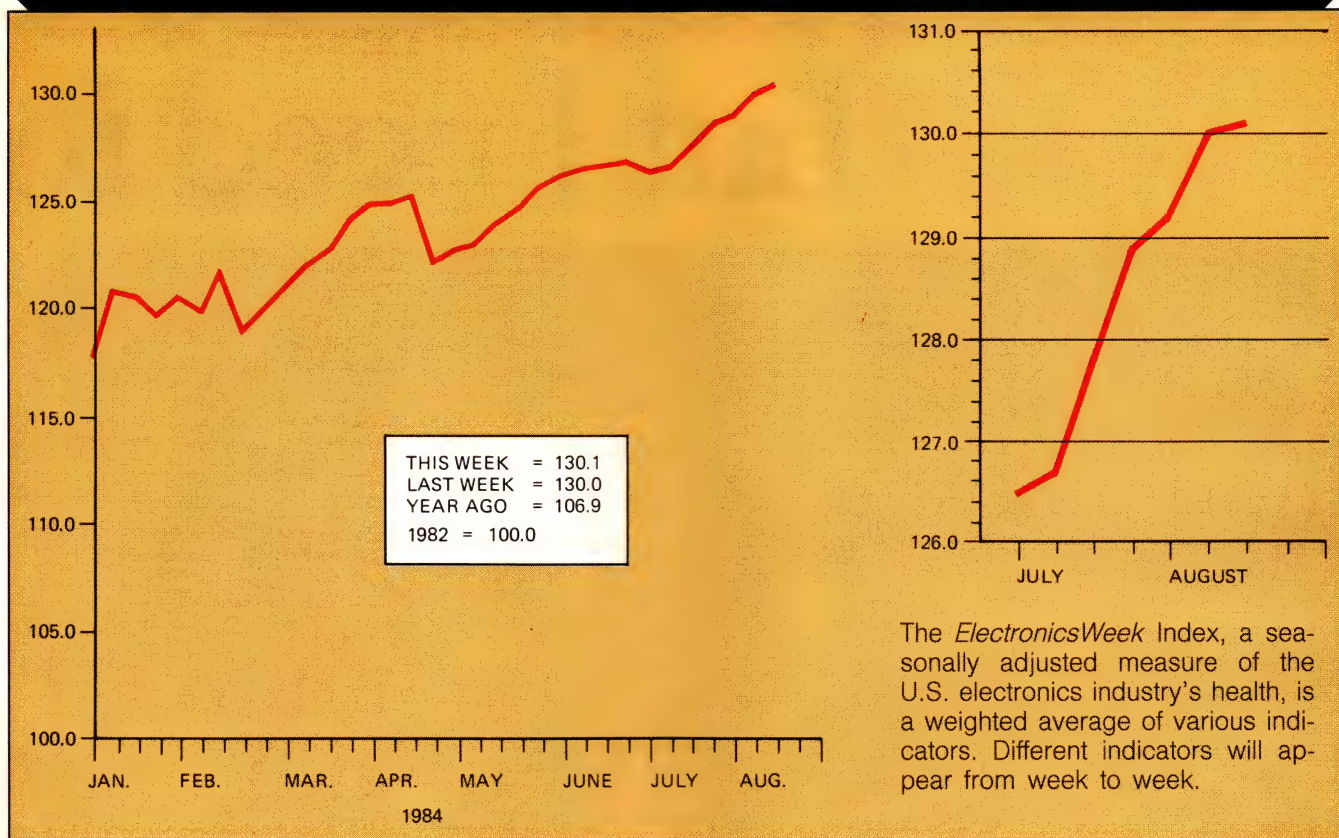
Eastern Area Sales Office

400 W. Cumming Park
Suite 2600
Woburn, Mass. 01801
1-617-933-0778
TELEX: 38-0123
NCR MED BOSTON

Western Area Sales Office

4655 Old Ironside Drive
Suite 400
Santa Clara, CA 95050
1-408-727-6575
TELEX: 17-1863
Answer Back LEGASPI UD

ElectronicsWeek Index



U.S. ELECTRONICS IMPORTS AND EXPORTS (MILLIONS OF \$)

	IMPORTS			EXPORTS		
	June 1984	May 1984	June 1983	June 1984	May 1984	June 1983
Accounting, computing, and data-processing machines	296.628	270.036	186.879	646.975	578.646	477.048
Calculators	45.740	38.988	31.895	8.654	6.760	6.877
Parts for data-processing machines and office calculators	328.999	336.780	269.712	555.610	521.358	424.492
Telecommunications, sound-recording, and sound-reproducing equipment	1,212.517	1,228.634	898.868	335.218	310.428	289.941
Electronic or electric instruments	110.383	110.460	78.968	499.349	513.826	473.177
Printed-circuit boards	19.823	20.943	15.825	22.854	19.446	14.779
Integrated circuits, diodes and other semiconductors, tubes, piezoelectric crystals, parts	633.579	664.625	461.572	529.263	481.575	398.586
Fixed and variable resistors	26.910	22.907	17.097	17.039	17.101	11.821

Thanks to the virtual elimination of the U.S. electronics industry's trade deficit, the *ElectronicsWeek* Index posted a slight gain in the latest week. Total exports of electronic equipment rose 6.7%, largely as a result of a 10.8% jump in exports of data processing equipment. This trade deficit reduction comes at a good time, because overall U.S. economic growth is

starting to slow; a large trade deficit would be a drag on the electronic industry's performance. The U.S. trade balance in electronic products could improve even further if the dollar were to weaken. The dollar's value did fall slightly with the recent small decline in interest rates. The federal budget deficit, however, will slow further progress by the dollar.

“Standard cells have
but I need to



many advantages, justify the cost.” With Texas Instruments, you can.

At a very early stage, you'll know what your standard-cell ICs from TI will cost. And you can depend on that estimate because TI commits to it.

TI's Standard-cell Design System is TTL based. That means we can quickly, easily, and accurately translate your TTL logic requirements into equivalent standard-cell functions to arrive at reliable cost figures.

In so doing, we will determine the chip size and the number of I/Os—major factors affecting costs. We will evaluate the advantages of various partitioning schemes and take into consideration packaging options.

TI will detail nonrecurring engineering costs—what it will take to get you prototypes—as well as recurring, or production, costs. We will tell you where these costs will occur and why they will occur. We will also suggest ways to keep them to a minimum. The result: No surprises along the line.

And in assessing the feasibility of TI's 3- μ m CMOS standard-cell technology for your logic, we may recommend TI's comprehensive gate-array family as the most economical alternative for you.

Count on significant system savings

Major improvements in system performance, reliability, and power consumption alone often justify the cost of standard-cell ICs.

In addition, there are more tangible system savings you can count on. One standard-cell IC can replace hundreds of individually packaged chips. Your system parts count is dramatically reduced. Printed-wiring boards can be fewer and smaller. Inventory and assembly costs are cut.

TTL design rules save time

Familiar TTL design techniques are used in the design of your TI standard-cell ICs. Actually, the process is very similar to breadboarding with standard TTL logic packages. Which means you

don't have to invest time and effort in learning new rules.

TI's standard-cell library contains all the popular SN54/74 functions you've worked with over the years. Plus RAM, ROM, PLA, ALU, and linear functions. As well as design-for-test cells that ensure thorough design testability.

You can draw your schematic or generate it via an engineering work station. TI's standard-cell library is supported on such third-party work stations as Mentor, Daisy, and Valid and on several PC systems. TI will provide the translation software for automatic generation of the TI design-description language.

TI Regional Technology Centers can add to your savings

You can hold costs down by performing much of the initial design work yourself. For example: Schematic capture, simulation, testability analysis, test-pattern generation, and the test-pattern grading required to finalize your standard-cell design. You can also perform the chip layout, or leave that to us.

You'll find these steps progressively easier as you execute subsequent stan-

dard-cell designs, but the first time you will probably need assistance.

That's where TI's convenient Regional Technology Centers come in. Strategically located throughout the country, they are staffed with standard-cell specialists who will provide whatever advice and counsel you need. Each Center has engineering work stations for your use plus the software tools and the computers necessary to complete your logic design. In short, the Centers are a reliable time- and money-saving design resource.

Our results pay off

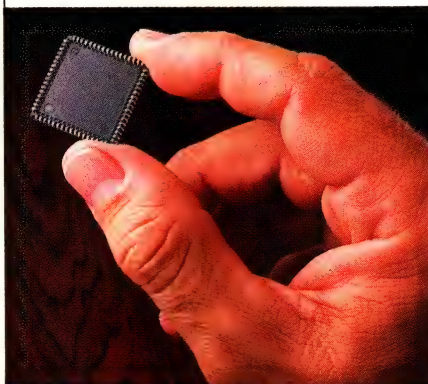
A number of simulation and testability steps are built into TI's standard-cell design flow. These checks and double-checks are vital to fulfilling our commitment to deliver prototypes that perform to your specifications. They help us achieve our goal of first-pass success, so you are spared any second-pass expenses.

Typically within 8 to 12 weeks after the initial design, you will receive prototypes for your in-system evaluation. You give us your okay; we produce and deliver in quantity.

Call 1-800-232-3200, Ext. 118

To find out more about the performance improvements and the economies that justify TI's standard-cell ICs, get our brochure, pocket selection guide, sample data sheets, and a more detailed description of the design process. Call the telephone number given above or circle the Reader Service Card number. Or write Texas Instruments Incorporated, Dept. SRS033EC, P.O. Box 809066, Dallas, Texas 75380-9066.

Breadboard on a chip: All the logic packages you might ordinarily put on a printed-wiring board could be functionally contained in a single standard-cell IC to achieve dramatic system cost savings.



**TEXAS
INSTRUMENTS**

Creating useful products
and services for you.

Circle 53 on reader service card

SRC DRIVES FORWARD AS TI, AT&T SIGN ON

Whatever happened to the Semiconductor Research Corp.? Everything, retorts SRC's executive director, Larry Sumney. And what is happening is good and getting better for the nonprofit industry cooperative based in North Carolina's Research Triangle Park.

When it was set up two years ago through the Semiconductor Industry Association, the cooperative promised to promote basic research and scientific study at colleges and universities, with emphasis on mathematics, the physical sciences, and engineering. Initially, that promise seemed beyond the grasp of the handful of corporate members that were paying for the first small, sparse office in nearby Arlington, Va., for Sumney and a secretary. But Sumney, who was the first director of the military's program on Very High Speed Integrated Circuits, seems to be building on that management success in his job at SRC.

Decisions by Texas Instruments Inc. and AT&T Co. to join SRC is one evidence of that. TI's action is particularly valuable to SRC's recruitment program because the Dallas company is widely regarded as a lone wolf that shies away from joint efforts. In addition, Sumney notes that SRC also has recently signed on such corporations as GCA, Sperry, and Zilog. Next year, SRC wants to push its membership roll from 35 to 40, with General Motors Corp. and Eastman Kodak Co. among the likely candidates.

Beyond the nearly \$12 million in research and development that SRC has spread this year among 33 colleges and universities—and the \$15 million budget that Sumney expects to work with next year—a move to limit participation to U.S.-owned firms is making SRC more appealing to domestic companies that find foreign competition increasingly severe.

Originally, SRC allowed foreign corpora-

tions to participate, provided that SRC and its members received equivalent access to foreign R&D efforts. This openhandedness generated "not a nibble" from abroad, says Sumney.

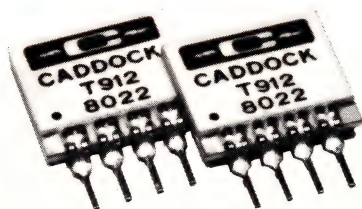
The North Carolina cooperative continues to recruit individuals with impressive credentials. Its most recent staff addition is William Holton, former chief scientist for TI's Semiconductor Division. At SRC, Holton will be in charge of programs dealing with research into design of microstructures, Sumney says.

"With people on board like Holton, who will get listened to very carefully by both academics and industry, SRC is building a strong image," says one government official. Privately, he adds that SRC established another friend in the Capitol when Erich Bloch was named to the top post at the National Science Foundation earlier this year. Bloch, then an IBM vice president, had served as SRC chairman of the board until he joined NSF.

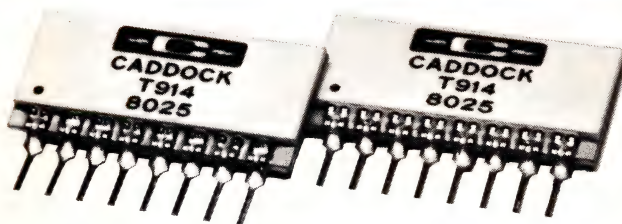
With Eugene Flath, vice president and assistant general manager of the Components Group at Intel Corp., replacing Bloch at the top of SRC, Sumney expects to continue using its funds to create major research "centers of excellence" at schools across the country. Envisioned are 8 to 10 more broad-scale, major research centers.

A half dozen high-caliber universities—the University of California at Berkeley, Stanford, Carnegie-Mellon, Cornell, the University of Illinois, and the Massachusetts Institute of Technology—have been brought on board by the SRC funding program. The program is also supporting a consortium of North Carolina universities, notably Duke, North Carolina State, and the University of North Carolina, working in concert with the Microelectronics Center of North Carolina. —Ray Connolly

Type T912 / T914 Ultra-Precision Resistor Networks from Caddock provide Ratio TCs to 2 PPM/°C and Ratio Tolerances to $\pm 0.01\%$ for precision analog designs.



Type T912 Ultra-Precision Resistor Network 'Pairs'



Type T914 Ultra-Precision Resistor Network 'Quads'

Type T912 / T914 Ultra-Precision Resistor Networks are constructed with Caddock's Tetrinox™ resistance films to achieve all of these high performance characteristics:

- **Absolute Tolerance:** 0.1% for all resistors.
- **Ratio Tolerances:** From $\pm 0.1\%$ to $\pm 0.01\%$.
- **Ratio Temperature Coefficients:** From 10 PPM/°C to 2 PPM/°C.
- **Absolute Temperature Coefficient:** ± 25 PPM/°C from 0°C to +70°C, referenced to +25°C.
- **Ratio Stability of Resistance at Full Load for 2000 Hours:** Within $\pm 0.01\%$.
- **Self Life Stability of Ratio for Six Months:** Within $\pm 0.005\%$.

This exceptional combination of performance specifications - and the compact, plug-in configuration of the Type T912/T914 precision resistor 'pairs' and 'quads' - provide the single-package

Standard models of Type T912 / T914 precision resistor 'pairs' and 'quads' include 14 off-the-shelf resistor values with a wide choice of Ratio Tolerances, Ratio TCs and Resistance Ratios:

This standard part number provides a selection of over 500 in-production models of Type T912/T914 precision resistor 'pairs' and 'quads':

T912 - A 1K - 010 - 10

Model Number: _____

Ratio Code Letter: _____

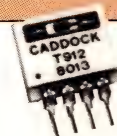
Ratio Temperature Track: (0°C to +70°C)
 -10 = 10PPM/°C -05 = 5PPM/°C
 -02 = 2PPM/°C

Ratio Tolerance:
 -100 = 0.1% -020 = 0.02%
 -050 = 0.05% -010 = 0.01%

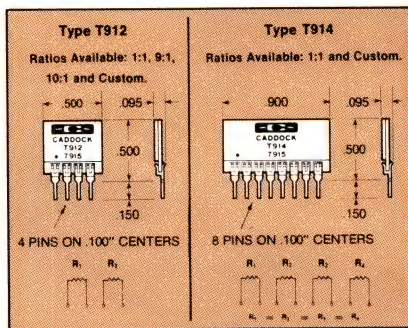
Standard Resistance Values (R₁):

1K	10K	40K	200K	500K
2K	20K	50K	250K	1 Meg.
5K	25K	100K	400K	

A - T912 with R₂ = 10R₁
 (Example: 1K - 10K)
 B - T912 with R₂ = 9R₁
 (Example: 1K - 9K)
 No Letter - T912 with R₂ = R₁
 No Letter - T914 with R₁ = R₂ = R₃ = R₄



As an example of the price/performance advantages of this advanced resistor technology, the Model T912-A1K-010-10 shown here provides a 1K-10K resistor 'pair' with a ratio tolerance of $\pm 0.01\%$ and a ratio temperature coefficient of 10 PPM/°C at a 1000-lot unit price under \$2.55. The same resistor 'pair' with a ratio tolerance of $\pm 0.1\%$ delivers at a 1000-lot unit price under \$1.50!



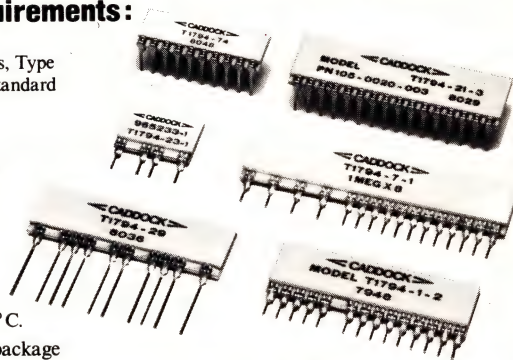
matched resistor characteristics and stability required by high-accuracy analog circuits, including -

- Precision analog amplifiers.
- Voltage reference circuits.
- Instrumentation bridge circuits.
- Voltage and current comparison circuits.

Type T1794 Custom Precision Resistor Networks meet special circuit and packaging requirements:

For medium- to high-volume applications, Type T1794 resistor networks provide all of the standard Type T912/T914 specifications, plus -

- From 2 to 15 resistors per assembly.
- Absolute tolerances from 1.0% to 0.01%.
- Custom voltage and power ratings.
- Resistance values from 500 ohms to 10 Megohms
- Absolute TC from 50 PPM/°C to 15 PPM/°C.
- Ratio TC from 50 PPM/°C to 2 PPM/°C.
- Variations in pin configurations and package size as required to meet performance and existing circuit-board arrangements.



Caddock's advanced film resistor technology is the source of these outstanding advantages—advantages that are matched by a 20-year record of outstanding 'in-circuit' reliability.

Discover how easily these problem-solving resistors can improve the performance and reliability of your equipment, too. For your copy of the latest edition of the Caddock 24 page General Catalog, and specific technical data on any of the more than 150 models of the 13 standard types of Caddock High Performance Film Resistors and Precision Resistor Networks, just call or write to -

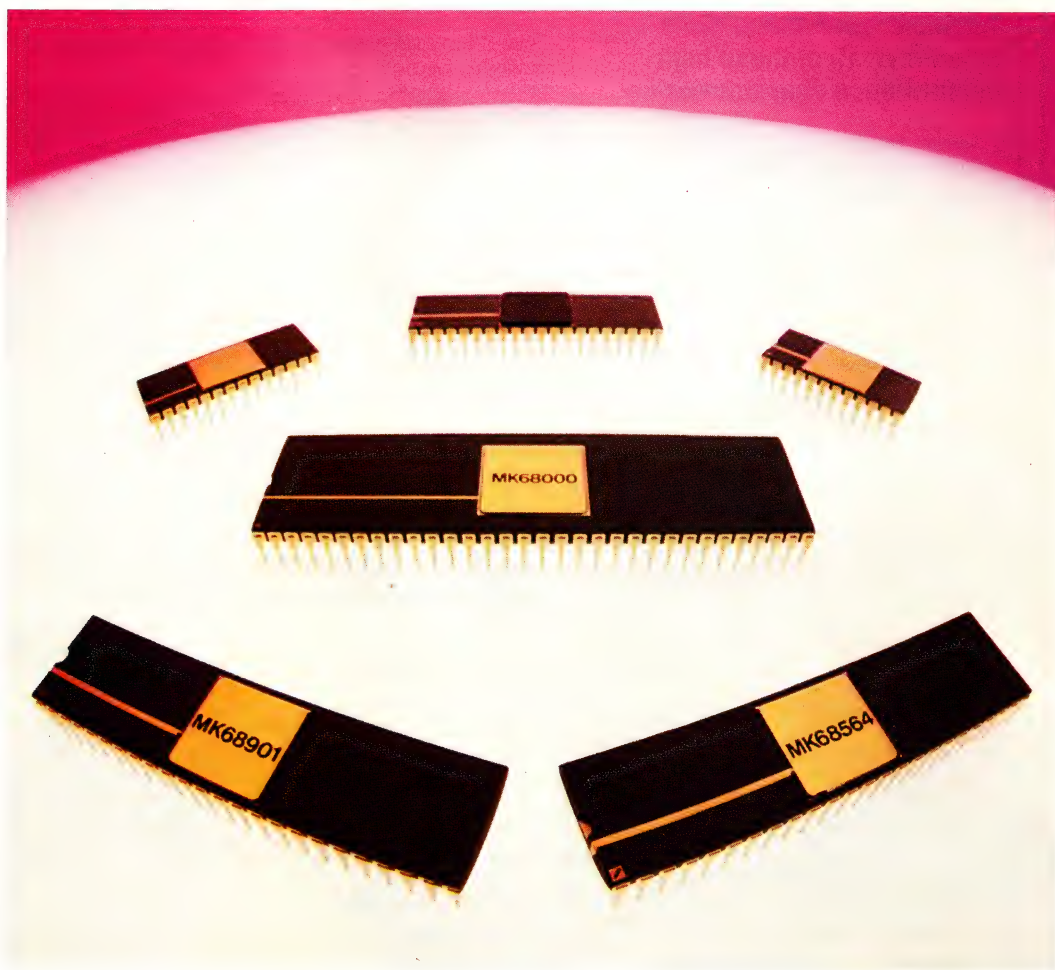
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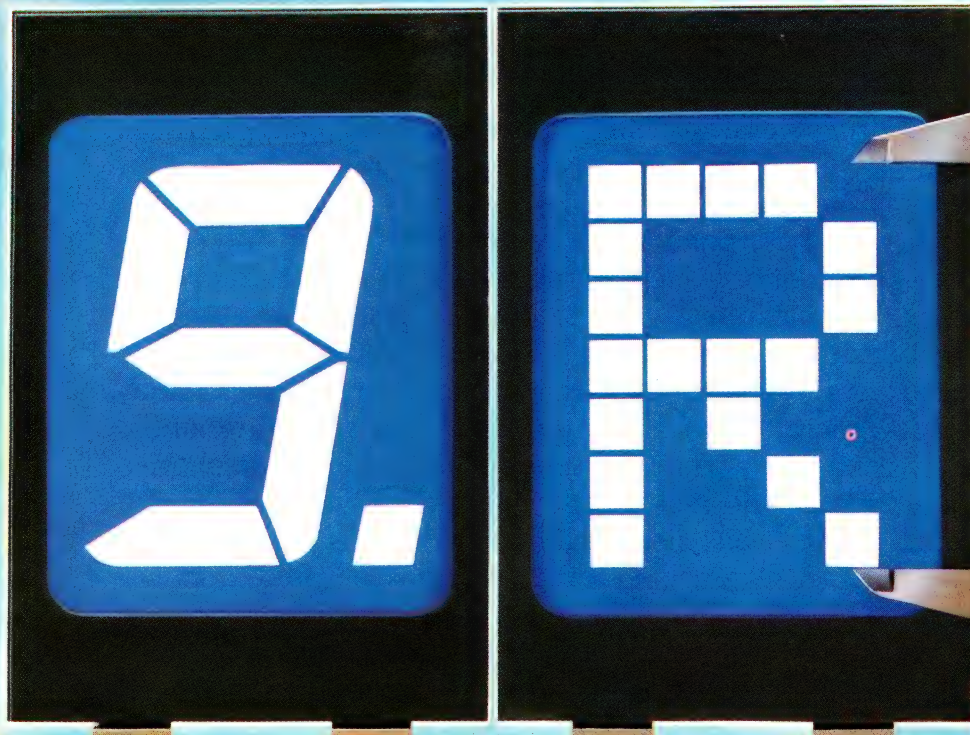
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AI A GROWTH INDUSTRY, SAYS ASSOCIATION'S BLEDSOE

Austin, Texas

Interest in artificial intelligence is up sharply and so is attendance at what once were small gatherings of academic and research leaders in AI fields. "There is some concern about the size of meetings," notes Woodrow W. Bledsoe, the new president of the American Association for Artificial Intelligence, which hosted its 1984 conference here this month.

Over 3,000 attended the meeting, with the largest growth in attendance coming from investors, start-ups, and large corporations seeking a piece of the emerging AI market. Bledsoe, who was among the group of researchers that founded AAAI in 1979, expects the total to easily top the 5,000 mark at the 1985 International Joint Conference of Artificial Intelligence, in Los Angeles.

An Oklahoma native who received his B.S. in mathematics from the University of Utah in Salt Lake City, Bledsoe went on to earn a doctorate in mathematics from the University of California at Berkeley. After working at Sandia Corp. in Albuquerque, N.M., Bledsoe and two associates founded Panoramic Research Inc. in Palo Alto, Calif., conducting AI development in pattern recognition.

There, Bledsoe worked on a system for facial recognition. For the past 18 years, Bledsoe has been at the University of Texas. In 1976, he served a one-year term as general chairman of the IJCAI. The 62-year-old professor of mathematics and computer science is now on leave from UT to direct AI/knowledge-based systems development as a vice president with Austin's Microelectronics and Computer Technology Corp., the industry consortium.

"I think the business interest is nothing but a big help," says Bledsoe. "You like for people to care about what you are trying to do. But I think one concern has to be that basic research goes on." Much recent

interest stems from commercial successes now getting publicity, says Bledsoe, referring to expert systems that help configure large computer systems from Digital Equipment Corp. and NCR Corp.

Expert systems—the strongest AI segment to date—are still in their



Leading edge. Woodrow W. Bledsoe sees AI research commercializing, maturing, and splitting into specialized factions.

early stages, he cautions. "I think it has tremendous potential, and I think it is here now, but people still have to do a great deal more before it can be declared a robust and viable product," he says.

After the crowded meeting in Austin, some informal proposals were made to split the AAAI conference into two events: one dealing with applied artificial intelligence, and another for basic research. "Next year it will be 5,000, and then maybe 10,000. If it does reach that point, it will probably fractionate into a number of meetings like so many other shows," Bledsoe speculates. "Already, it is beginning to split into subgroups. We've got one on knowledge acquisition, another on learning, and still more.

"At next year's meeting—if the economy does not suffer a downturn—I think we will see a larger crowd and more companies reporting on their research. This year, most of the papers still came from universities. You'll see more products in the form of software," Bledsoe believes. But still, he adds, AAAI conference leaders intend to respond to the need of basic researchers to convene and compare progress on long-term goals.

—J. Robert Lineback

Santoro turns custom chips to standard at Silicon Systems

Tustin, Calif.

Until Carmelo J. Santoro took the helm two years ago at Silicon Systems Inc., there was more than a little doubt about whether custom and standard integrated circuits could exist under the same roof on equal terms. Moreover, the semiconductor firm was on shaky financial ground, running in the red on annual sales of only \$13 million.

Santoro, 43, clearly had a tough challenge; how well he has met it

shows dramatically in SSI's latest financial report. For its third quarter, ended June 30, bookings increased fourfold, revenues tripled—putting the company at nearly a \$60 million rate—and profits zoomed from earlier depressed levels. In recognition, the board of directors named him chairman in late July—adding to his roles as president and chief executive officer.

When Santoro arrived at the company, he faced the classic dilemma of

custom chip houses: "One product to one customer limits your growth." SSI had gained a solid reputation for its engineering of such parts as dual-tone multifrequency decoders for telephones, but as Santoro diplomatically notes, "they had poor financial sensitivities." One example: the firm was in the early stages of building a chip-making facility costing \$17 million—more than annual sales—without the proper backing.

The energetic Santoro, who holds a Ph.D. in solid state physics from Rensselaer Polytechnic Institute, attacked the problem with characteristic vigor, turning custom chips into standard parts and bearing down on two niches: telecommunications and computer peripherals. To make this work, he had to convince the customer for whom the design was created to allow SSI to market it widely. "This is not an easy task," he explains in an understatement. But by offering such sweeteners as guaranteeing customers head starts in using the chips and cash payments, he has pulled off the feat. Santoro owns



Title collector. Following his success in resuscitating Silicon Systems Inc., Carmelo Santoro was elected board chairman as well as president and CEO.

up to being a dogged bargainer, even to the lengths of threatening to "camp out in his office until we got an agreement."

Santoro's efforts to revamp the company's organization have been based on lessons he learned at previous posts at Motorola Semiconductor Products Inc. and American Microsystems Inc. From Motorola comes the policy of "driving decisions down and decentralizing." From AMI, "vertical communication, one-on-one, so all the staff knows what's going on."

—Larry Waller

New, faster modems to make remote computing look local, Maxwell says

Milpitas, Calif.

After 10 years as head of engineering and product development for Racal-Vadic, the modem company he founded here, Kim Maxwell is ready to try again as president. "At 43, I'm ready to do some of the things that I didn't have the experience—or courage—for at 33," he says.

In 1974, after a two-year stint, he stepped aside as president; he returns at a time when the company has grown from \$3 million in revenue and 77 employees to over \$100 million and about 1,000 employees. The architect of that growth, Elwood "Pete" Bolles, who succeeded Maxwell as president, has stepped up to board chairman.

A former philosophy and mathematics student and peace activist at

Stanford University in the 1960s, Maxwell is the inventor of the 1,200-baud full-duplex modem and has guided his company's technical development. He retains a strong interest in the connection between social organization and technology; his commitment to social issues shows in the fact that Racal-Vadic accepts no military contracts and does not require its employees to wear badges.

Racal-Vadic is now a wholly owned subsidiary of the British firm, Racal Electronics Ltd., Bracknell, Berkshire, UK, and has diversified into the consumer business with a line of personal computer modems dubbed, naturally, the "Maxwell." This segment accounts for only 15% of R-V's business, but switched network modems in general are a rapidly growing segment of the communi-

cations market, Maxwell says.

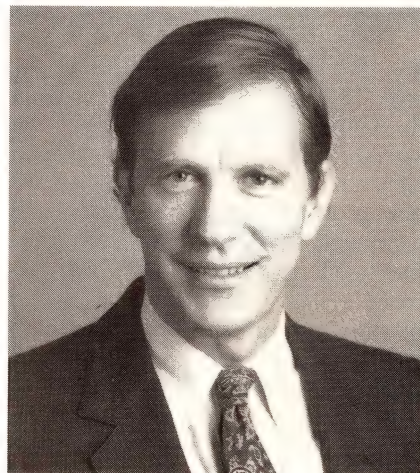
"There are now some 130 million terminations in the switched phone network in the U.S.," Maxwell notes. "By the end of this decade there will be some 20 million personal computers, about a third of them portables. They all need to communicate with more than one destination: corporate computers, electronic mail, other PCs, remote data bases, etc."

Digital telephone service will remove the need for modems, but, Maxwell asks, "how fast can you replace 130 million lines?" Not before digital service encompasses almost all businesses, "and that won't happen before the end of the century."

In the meantime, Maxwell says, the advent of high-speed asynchronous modems—up to 9,600 baud, the most common terminal-to-central-processing-unit data rate—will make remote computing look just like ordinary terminal use. "The user of a 3274 PC can effectively take it home and it will work just as fast over the phone." The 9,600-baud modem will be here in two years, he predicts; 2,400 baud modems priced at under \$800 will be on the market this year.

As president, Maxwell sees as his primary responsibility making people productive. "However, I don't set goals for them—they do that for themselves. I'm president in some respects by election, in others by right. I can speak with some authority and expertise on many subjects. For the rest, we have to construct a system that will give a warning when something is about to go haywire," he says.

—Cliff Barney



Welcome back. Kim Maxwell returns to guide Racal-Vadic, the modem company he founded, into the personal computer age.

RCA SETTLING DOWN TO GATHER CMOS

Somerville, N.J.

Mention RCA Corp. to people who follow the semiconductor industry, and the usual response is that the firm's Solid State Division, based here on former New Jersey farmland, is "lackluster."

True, the firm is one of the top 10 semiconductor makers in the U.S., as ranked by Integrated Circuit Engineering Corp., Scottsdale, Ariz., (see table, p. 62) and its estimated semiconductor sales of \$315 million this year rose from \$220 million last year. But analysts maintain that its growth is a function of the soaring post-recession demand for electronic products that has pushed just about all semiconductor manufacturers to new highs [*Electronics*, June 14, 1984, p. 125].

RCA's semiconductor performance leaves a lot to be desired, says James I. Magid, who follows RCA for L.F. Rothschild, Unterberg, Towbin, of New York. "They've gotten into the black [in 1984], but everybody's making money," he says.

The division seems to have no sense of urgency, Magid notes, although he points out that the chip division has done well as part of a larger corporation. Other observers, however, such as William I. Strauss, vice president of In-Stat Inc., a semiconductor market research firm, in Scottsdale, think the connection with its parent may have hindered the division, as it has not received the same support other divisions have.

"I think it has suffered from a lack of commitment," Strauss says. "It seems to have taken a back seat to RCA's government systems business" as well as the consumer electronics business.

"RCA is still searching for something to get ahold of in the semiconductor business," believes William J. McClean, an ICE analyst. "They're in our top 10 list, but they're not one of the most dynamic firms." Despite

an expected 43% gain in business this year, RCA Solid State's growth is "slightly below the U.S. industry average of 54%," McClean says. He estimates that RCA's business next year will grow in the range of 20% to 24% versus the U.S. IC industry average of about 24%.

RCA's performance seems destined for change, though. Pushed by new corporate management, executives at the Solid State Division have devised a new strategic plan to solidify RCA's position in a key area of chip technology: complementary-MOS.

"Our goal is to be a major industry factor in CMOS," says Carl Turner, division vice president and general manager of RCA Solid State. "Concentrate and focus—those are the two key words. We're not trying to be everything to everybody," he ex-

plains. "We want to deal in areas where we can find a niche."

The inventor of CMOS technology way back in 1962, RCA Solid State has been waiting for applications to catch up with the technology. "Not until the last two or three years have the prophecies about CMOS proven accurate," Turner says. As for its place in the market, "CMOS will dominate in the next decade because of its speed and power advantages. The CMOS revolution is upon us."

RCA wants to capitalize on that revolution. Its plan calls for the Solid State Division to maintain its position in the overall integrated-circuit market while it increases its CMOS business at a rate of 35% to 40% a year, according to Turner. "We won't lose market share and we could gain."

Some industry watchers



Strategy. RCA's goal "is to be a major industry factor in CMOS," says Solid State Division head Carl Turner.



New focus. The new RCA strategy requires a change in marketing, notes marketing leader Herbert V. Criscito.

are not quite as optimistic, pointing out that while RCA has been waiting for CMOS markets to open up, other chip makers have muscled into the nascent business. "They were the leaders in CMOS. It remains to be seen whether they can rise again," says In-Stat's Strauss. Adds McClean of ICE: "RCA invented CMOS. It should be head and shoulders above the rest. That's not the case." RCA didn't pursue the CMOS market in the 1970s as strongly as other firms, McClean says. "Now, when it is projected to be a major factor and other firms are getting into it heavily, they let everybody catch up."

Capital plans. To increase its presence in the CMOS area, RCA Solid State plans to invest \$100 million this year, and has budgeted a 60% increase in spending next year for research and development and capital equipment, most of it for its plant in Palm Beach Gardens, Fla. "That's a record investment for Solid State," Turner says, "and a substantial amount for RCA."

Products covered under the plan include CMOS dynamic random-access memories, CMOS read-only memories, gate arrays and standard cells, and MOS field-effect transistors. The firm is also looking into ultraviolet and electrically erasable programmable ROMs, erasable programmable logic arrays, and EEPALAs.

RCA is also strongly committed to CMOS logic devices, such as 8-bit CMOS microprocessors, under an agreement with Motorola Inc., Turner says. As for 16-bit and 32-bit microprocessors, his division is talking with one of the three leading microprocessor makers: Motorola, Intel, and National Semiconductor. He sees future work in CMOS microprocessors by RCA "not as a main thrust, but as a complementary thrust" for the division. "The only area we're not making a major effort in is static RAMs," Turner says. "We'll supply them, but we're not putting a lot of muscle into it."

Besides targeting certain products, RCA is targeting certain applications areas, says Herbert V. Criscito, divi-

sion vice president, marketing. These include high-growth areas such as work stations, telecommunications equipment, and automotive products. "We're focusing our sales and marketing operations to fall in line with our plan regarding who our customers are and how we call on them."

Turner emphasizes that senior management is supportive of the Solid State Division's plan for improved growth, citing the planning impetus provided by RCA president Robert R. Frederick, who was hired from General Electric Co. RCA has been repositioning itself as a major factor in the electronics, communications, and entertainment industries.

The Solid State Division, in Turner's view, is now seen by higher management as a vital part of RCA.

"They recognize that to be successful in electronics, they must have a solid-state enterprise," he says.

Charles Ryan, an analyst with Merrill Lynch Pierce Fenner & Smith, New York, agrees that the parent firm is cognizant of the division's importance. "RCA integrates chips in their government systems and consumer business. Solid State enhances those businesses. As a result, [top management] is satisfied with less of a profit,"

because the other areas are enhanced. "But they are dissatisfied with their ranking in the industry," Ryan notes. Because of the increased research and development spending and heightened management attention, "things look a lot better now."

Captive sales account for about 10% of the division's business, Turner says. "Our thrust is to support the parent's needs and participate in selected sections of the merchant market."

Noting that RCA is "very successful in government systems and the consumer business," Turner says the parent "needs good in-house ICs to support that. And to be successful with an in-house operation, you must be successful in the merchant business."

—Robert J. Kozma

TOP TEN U.S. IC PRODUCERS				
1983 rank	Company	IC production (\$ millions)		1983/1984 % change
		1983	1984 (forecast)	
1	TI	1,505	2,230	48
2	Motorola	1,040	1,575	51
3	National	800	1,150	44
4	Intel	765	1,170	53
5	AMD	490	890	82
6	Signetics	415	700	69
7	Fairchild	380	475	25
8	Mostek	300	430	43
9	RCA	220	315	43
10	AMI	165	250	52
	Total	6,080	9,185	51

SOURCE: INTEGRATED CIRCUIT ENGINEERING CORP.

Digital Switch finds new direction profitable, expects to gross \$360 million this year

Richardson, Texas

In March 1981, Digital Switch Corp. had a sudden corporate rebirth. The firm, which started in 1976 with designs to offer digital switching systems for the central office market, altered its strategy. With changes in software, it aimed its new telecommunications equipment at emerging independent long-distance carriers, figuring there would be an unfilled need from these independent common carriers, such as MCI Communications, Sprint, and the like. A year later, revenues leaped into hyper-growth, swelling to \$44.1 million in the first quarter of 1984 from virtually nothing in the first quarter of 1982, when the company was in

what was largely a developmental stage.

Moreover, Digital Switch went from losing \$1.3 million a quarter to earning \$8.7 million in the most recent quarter. Its acquisition last April of Granger Associates, in Santa Clara, Calif., pushed sales to \$87.2 million and earnings to \$14 million in the second quarter, ended June 30. Most company observers now expect revenues to hit \$360 million in 1984.

Digital Switch's growth has made it a hot item on Wall Street as well as with industry analysts. "This is clearly one of the most exciting emerging companies I have come across," maintains Andrew Schopick, vice president and senior analyst

across," maintains Andrew Schopick, vice president and senior analyst tracking Digital Switch for the Gartner Group, in Stamford, Conn. "It is a remarkable story in terms of the speed and success with which this firm was able to identify and exploit a market opportunity—namely, the so-called tandem switch class for common carriers." Tandem switches are used to route incoming long-distance calls to the local central office, where the call is then switched to its destination telephone.

Concern. The concern voiced by some company observers is over Digital Switch's ability to translate its success with long-distance equipment into other, more competitive markets—such as the huge central office business. "I happen to be in the camp that says I'm not going to bet against these people. If it can be done, they can do it," adds Schopick.

Despite such glowing appraisal, company management in this Dallas suburb is not ready to celebrate or remain complacent. In fact, for the second time in a year, corporate revenue goals have been doubled, placing the new target at \$2 billion by the early 1990s.

"Leave absolutely nothing to chance" has become the company motto, instituted by Digital Switch president James L. Donald, who left archrival Northern Telecom Inc. in 1981 to redirect the fledgling firm. Digital Switch, which has nearly \$100 million in cash on hand for future needs, continues to be aggressive in technology and the market but remains very conservative in company management.

"In reality, the company was born again, so to speak, in March 1981," says Richard L. Scroggins, its vice president and chief financial officer. At that time, management "looked at the product and realized that it was too far away from a Class 5 switch [needed for the central switching office markets]. So it was converted to a long-distance switch to serve a blossoming business that no company was serving. The new corporate leadership moved [the firm] to Texas [from its original home in Virginia] and took on a year-long redevelopment program to create the first Class 4 digital switch for long-distance markets."

Digital Switch thought the market

for central office equipment was inviting, since the telecom industry was preparing to make the big switch from analog to digital technology. The firm had a new distributed processing architecture, but the concept was ahead of available semiconductor technology. A hardware prototype was not ready until 1980.

Meanwhile, Donald was ready to leave Northern Telecom. The Canadian telephone giant had acquired his long-distance switching operation in 1978 through its purchase of Dan-

early 1986.

Working with Motorola Inc., Digital Switch is developing software-based equipment for cellular radio systems. Motorola has agreed to buy its cellular switches from Digital Switch through 1990. Shipments are expected to begin in 1985. The firm is also working on software to serve tenant switching markets, which, like private branch exchange systems, serve a single site but handle more than one business. It sees this market reaching \$150 million in 1984.



Beneficial. A change in direction for its telecommunications equipment proved profitable for Digital Switch Corp., allowing it to acquire a firm and become a darling of Wall Street.

ray Inc., in Dallas. But Northern Telecom's resources were mostly earmarked at increasing its presence in the U.S.'s central office business. The new breed of independent long-distance firms (primarily MCI) were ready for a new equipment supplier: moving to Digital Switch, Donald—along with a several former Danray associates, including James M. Nolan, now chairman of Digital Switch—repositioned the five-year-old firm into the exploding telecom marketplace.

Starting over. The firm has grown from 11 employees in 1981 to over 1,100 in 1984. It is now preparing to expand beyond long-distance markets and enter the originally targeted central office segment. With much of its development work centered in software, a prototype central switching system is being readied and is expected to hit the market in late 1985 or

It is the long-distance trade, however, that has turned on Digital Switch's revenues and sales. Based on Zilog 16-bit Z8000 microprocessors, the firm's switches offer up to 30,000 ports and have captured 60% of the non-AT&T long-distance equipment sales, claims Scroggins.

Last month, the firm began shipping what is known as equal-access software for its long-distance switches. Aimed at assuring higher line quality, equal-access features have high priority among independent carriers as they compete with AT&T. Other software features are being added, such as the capability to provide operator assistance.

The merger with Granger—a supplier of signal processing equipment—has accelerated Digital Switch's expansion plans. The deal immediately yielded a number of needed products, such as echo cancelers,



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MAN6140	2 Digit; Common Cathode; Rt. Hand Decimal Point
MAN6150	1½ Digit; Common Cathode; Overflow ± 1.8. Rt. Hand Decimal Point
MAN6160	Single Digit; Common Anode; Rt. Hand Decimal Point
MAN6175	Single Digit; Common Anode; Overflow ± 1. Rt. Hand Decimal Point
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1984 Issue dates.

October 1, 1984
December 1, 1984

1984 Closing dates.

September 1, 1984
November 1, 1984

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DISTRIBUTORS POISED TO ENTER THE 'FOURTH ERA'

While nurturing its traditional components business, the evolving electronics distribution industry shifts to systems and beyond □ by George Leopold

Led by a strong recovery in its traditional components sales, a burgeoning systems business, and a risky but potentially profitable partnership with semiconductor manufacturers to design semicustom integrated circuits, the electronic distribution industry has rebounded strongly since late 1982. As the industry moves through a period of unprecedented change, national and regional distributors are attempting to position themselves within one or more of these three segments.

"About three years ago, I said there'll be more changes in the distribution business in the next three to four years than all the changes in the past 25 years," recalls Anthony R. Hamilton, chairman of Avnet Inc.'s giant industrial electronics distributor, Hamilton-Avnet Electronics Marketing Group, of Culver City, Calif. Citing the increasing number of national distributors, new technology, and Wall Street's grudging recognition of the distribution industry—particularly the large sums it has provided distributors over the past two years—Hamilton concludes, "We are having just that."

The electronic distribution business is growing so fast that, in 1983, Hamilton-Avnet Electronics Marketing Group, by far the industry leader, sold computer products at a rate of \$1 million a day, a sum greater than the total generated by the entire distribution industry 25 years ago. For fiscal 1984, Avnet Inc. will report annual sales of \$1.64 billion, Hamilton says.

Distribution growth

From its humble origins in New York's Radio Row in the early 1920s, the electronic components distribution industry grew 24% last year to \$5.2 billion, or nearly one quarter of the sales for the entire electronic components industry (Fig. 1). Sales are expected to grow through 1986, to \$10.5 billion, according to industry analysts Hambrecht & Quist Inc. of San Francisco.

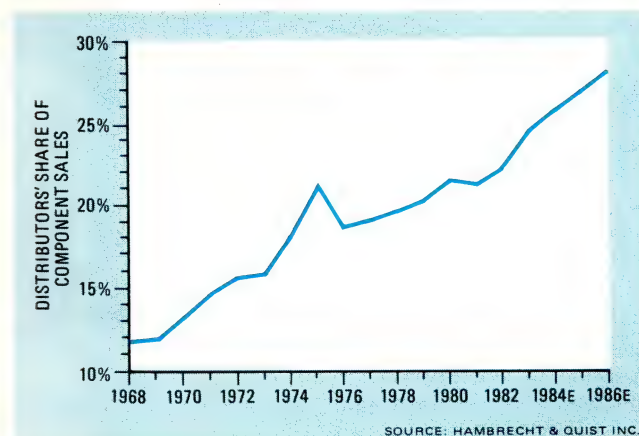
Slowed by the recession in the early 1980s, distribution's sales are enjoying an upturn that began in late 1982, coinciding with the national economic recovery. Despite recent lows on the New York Stock Exchange, the industry is confident that it will continue. "We have had confidence in the upturn and our confidence has not

been changed as yet," says Hamilton (Fig. 2). "We do not see statistics at this moment—they may turn up tomorrow or the next day—but at this moment we don't see statistics in front of us that would make us change our planning for an upward direction in our business."

Like other public companies, distributors feel pressure to grow in order to satisfy their stockholders, explains Bill Meserve, senior management consultant for market research analysts Arthur D. Little Inc., in Cambridge, Mass. "The character of the industry is changing and part of that is the desire for growth." And as industry leaders such as Hamilton-Avnet, Long Island distributors Arrow Electronics Inc. and Schweber Electronics, and, among West Coast companies, Kierulff Electronics Inc. and Wyle Laboratories demand a larger market share, capital needs have increased making it tougher on smaller regional distributors.

Indeed, even though it had \$100 million in the bank, Hamilton-Avnet went out last November to acquire an additional \$100 million. "And wouldn't you know it, we used up that \$100 million-plus to finance the growth in fiscal 1984," reports Hamilton.

Faster inventory turns appear to be another way of



1. Components sales growth. Following a downturn in the early 1980s, distributors' sales of electronic components now account for nearly one quarter of the components industry's total sales.

2. Confidence in the upturn.

Hamilton-Avnet's Anthony Hamilton stresses the good relationship between his company and the financial community: "We have an increasing amount of our stock being held by financial institutions, over 60% right now."

sustaining growth. "To the extent that it's possible to turn inventories faster, you can reduce the amount of capital you require for each dollar of sales," explains Stephen P. Kaufman, president of Arrow's Electronic Distribution Division in Melville, N.Y. (Fig. 3). "So if your inventory turns [go up] from three to four, you can reduce the amount of capital necessary from 30¢ per dollar sales to 22¢ per dollar sales." Kaufman expects most major distributors to be operating consistently at the rate of four to five inventory turns by the end of the decade.

"On the one hand, it is very desirable to turn inventories fast," he adds. "On the other hand, it is our very strong belief that using modern-day management technology such as on-line real-time computer systems and sophisticated forecasting systems, we can turn the inventories at five times a year but still offer superior service to the customer."

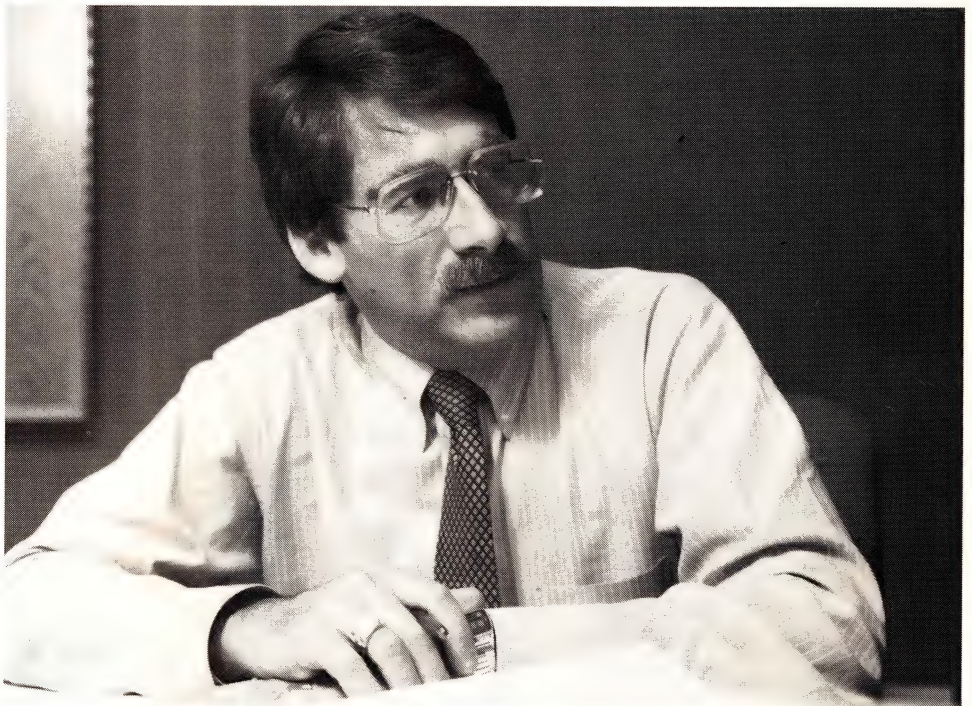
Distribution's bread and butter continues to be the traditional components business: selling semiconductors, computer products, connectors, resistors, and passive components primarily to original-equipment manufacturers in various electronics industries (Fig. 4). Indeed, most of the top 10 distributors reported that at least 50% of their 1983 sales were from either active or passive components.

About 10 years ago, Powell Electronics Inc., a privately held Philadelphia components distributor with fiscal 1984 sales of approximately \$60 million, decided against entering the systems business to concentrate instead on switches and connectors. "Trying to be all things to all people doesn't always work," maintains Dick Campbell, Powell's di-



rector of marketing, in explaining its decision to remain in the passive components niche. About 85% of Powell's fiscal 1984 sales were in switches and connectors, Campbell adds.

Although most distributors continue to stress the importance of their components business, the basis for distribution's growth since World War II, the industry has clearly shifted to what Charles M. Clough, president of Wyle Laboratories' Electronics Marketing Group in Ir-



3. Service still crucial. Along with the technical ability of managers and the sales force, distributors can keep pace by maintaining a high level of service. "That's how we expect to differentiate ourselves—offering more services and better services to our customers," says Arrow's Stephen Kaufman.

vine, Calif., calls "the fourth era of electronic distribution" (Fig. 5). From the vacuum tubes first sold to ham operators and foreign sailors on Radio Row (Cortlandt Street in lower Manhattan) to transistors and ICs, distribution has now moved on to the systems business, Clough argues.

"It's like a blind dog in a meat shop," says W. Donald Bell, president of Kierulff Electronics Inc., in Los Angeles, referring to the unrecognized potential of the systems market (Fig. 6). Of Kierulff's 1983 sales, totaling \$274 million, 19% came from computer systems, he says. Four months ago, Kierulff formed a value-added reseller group geared to systems business. "We intend to drive that business very aggressively," adds Bell, who predicts that 30% of all computer-related equipment will be sold by distributors and other third-party sellers by 1986.

Besides their traditional industrial base and the value-added business, Bell says the third part of Kierulff's systems strategy is the commercial end-user. In early August, Kierulff acquired MTI Systems, a Port Washington, N.Y., systems distributor for \$16 million. MTI has been involved in the rental and leasing of printers, terminals and other computer peripherals, and systems integration. "What we're trying to do is assemble the resources to service the three customer bases [within the distributor's systems business]," Bell says.

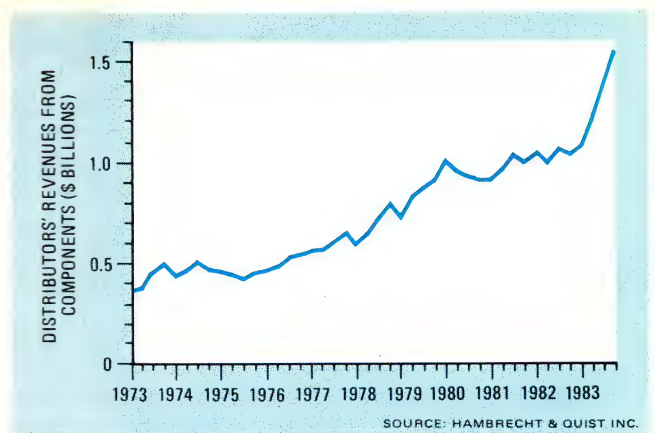
But William T. Jones, vice president of systems business development at Hall-Mark Electronics Corp., in Dallas, believes many distributors are still trying to determine whether they can make a profit in the systems business. "We really all got into the systems business—kind of dragged into it—because our semiconductor manufacturers decided to do board-level value-added products and develop systems for microprocessors," remembers Jones. "We started putting in a lot of technical people and demo centers to support that."

Challenges similar

Fundamentally, explains Toby Mack, executive vice president of the National Electronics Distributors Association [NEDA] in Park Ridge, Ill., distributors face the same challenges in systems as they did in components: leveraging their assets, competing in a fast-changing market, and knowing that market. Right now, Mack says, the systems market is industrial OEMs.

Indeed, most distributors agree that the profitability of the systems market is in industrial, not consumer-oriented, systems. Noting that less than one third of the firm's systems business was on the commercial side, Avnet's Hamilton says "the big growth that we've experienced in computers has been in the industrial distribution business." Indeed, Hamilton-Avnet recently closed its retail computer business, a move necessitated by growing inventories of machines, including those from IBM Corp. "When we recognize [problems], we do make moves," he adds.

Hall-Mark's Jones concurs, cautioning that systems distributors must distinguish fads from real products. The cost of building up system-level products is much higher, he maintains, hence firms cannot afford to invest in a product only to see sales disappear quickly. For that reason, he thinks consumer-oriented systems will always be the riskiest for systems distributors. Clough agrees,



4. Distributors' components revenues. After experiencing slow growth over the the two previous years, the distribution industry recovered dramatically in 1983.

adding that by shying away from the retail systems market, Wyle has been able to build up its technical base.

According to Hamilton, "The gross profits are going to go up in the systems business because it requires more work to get the sale and it requires a different type of selling. The supplier is going to have to give the distributor additional profits to keep it a wholesome business, in order to keep distribution a wholesome outlet for the supplier."

Distributors as designers

The trend toward expanded systems business appears inevitable, according to most industry spokesmen, but the name of the game is still going after new product lines, maintains Kierulff's Bell. At the same time, Bell and, to a lesser extent, others are skeptical about the latest trend within distribution: agreements with suppliers to assist customers in designing custom and semicustom ICs, especially gate arrays. Although Kierulff will probably join the fray in the next six months to learn more about the technology, says Bell, "it's the biggest overblown project in the industry today."

Moreover, no new product has yet emerged from the many design agreements signed thus far. "Nobody's making any money on it, and they may not for a long time," Bell argues. "It could be a lot of money down a dry well."

A recent agreement with RCA Corp.'s Solid State Division, Somerville, N.J., to design complementary-MOS logic arrays and standard-cell ICs notwithstanding, Tony Hamilton expresses a similar view regarding custom and semicustom chip design. "A distributor better know what his aim is, he better have a strategy, because, once again, this could be an endless pot as far as investment is concerned." Hamilton-Avnet is committed to opening 12 design centers over the next year to assist customers with designing products based on the RCA chips.

The gate-array design business will develop more slowly than computer products sales, Hamilton adds. "Even though it's going to be a profitable business for distribution, in my opinion, it's going to take longer to make it profitable."

Al Caplan, vice president of LSI Computer Systems

Wyle's Timmins has designs on ICs

Although there is considerable skepticism concerning how big a role a components distributor can play in hawking such semicustom integrated circuits as gate arrays, Richard F. Timmins counts himself among the true believers. His present post might give him a positive bias, however: as marketing manager for semicustom ICs at Wyle Laboratories' Electronics Marketing Group, his assignment is to organize this operation from the ground up.

But even at this early stage, Timmins has more than blind faith on which to base his upbeat prognosis. Wyle already represents LSI Logic Corp. gate arrays at its flagship distribution office in Santa Clara, Calif., and has been actively introducing the product to its customer list. "In just two and a half weeks, our sales people have dug up 23 leads," Timmins says this result is gratifying, but even more promising is that only five of them were already known to LSI Logic. According to the Wyle executive, a better example could not be offered to illustrate what distributors can bring to the semicustom manufacturer, which he calls a brand new customer base.

Timmins, at 39 an industry veteran with some 17 years of logic and software design experience, was tapped by Wyle boss Charles Clough in January to study whether the distributor should jump wholeheartedly into the semicustom business. Clough gave Timmins three months to study the problem, with the instructions to "take your time, do it right. Even if the answer is No, don't worry." His conclusions convinced Clough, and Timmins has been putting the operation together ever since.

After identifying the product types Wyle would handle—a major job in itself, because the terminology varies from company to company—Timmins tackled what he calls the toughest job of all: filling out the line card, which is the way distributors describe the companies that they represent. These firms are steadily dropping into place. Besides LSI

Logic, Wyle has signed Altero Corp. as supplier of erasable programmable logic devices, sometimes called E-gate arrays. This Santa Clara firm has a 300-gate device, in CMOS, that Timmins predicts will become a very hot item. For programmable array logic, Wyle has three major semiconductor houses on board supplying noncompeting chips: AMD, Inc., Texas Instruments, Inc., and Signetics Corp. Rounding out the lineup is NCR Corp., with whom Wyle signed an agreement to supply standard cells in early 1983. This pact already has produced some important design-ins for the company, he says.

All that remains to complete the Wyle application-specific IC roster is to represent a manufacturer of computer-aided work stations, and negotiations are underway with several firms. As for independent IC design services, Wyle will offer those, too, with its own resources.

Though other distributors are also setting up semicustom operations, Wyle is doing it differently. The company has signed only one firm in each category, believing that in such a technology-intensive field, it is impossible to get up to speed with multiple suppliers. "I want my design engineers to be as knowledgeable as those inside LSI Logic," Timmins notes.

At present, he has a top IC designer on board at the Santa Clara office and expects to be fully staffed with four engineers when the new design center opens there in early October. Timmins expects to have a designer hired for the Irvine, Calif., office within weeks and hopes to open up for business by January 1985.

During an engineering stint at Texas Instruments, where he spearheaded the opening of its Southern California regional technology center, Timmins acquired similar experience in setting up new design operations. But the Wyle job is more challenging and "really a fun thing, especially since Charlie [Clough] is 100% committed to it." —Larry Waller

Inc., a chip manufacturer in Melville, cautions that the growing number of first-time customers and designers may require a degree of hand-holding at the beginning. Moreover, he says, "there's a limited amount of computer time available."

"I don't think it has grown as fast as we anticipated," agrees John Dunleavy, vice president and director of distribution marketing for Motorola Inc.'s Semiconductor Products Sector, in Phoenix, Ariz., which has semicustom IC design agreements with both Hamilton-Avnet and Schweber Electronics, Westbury, N.Y. Dunleavy cites distributors' capacity restrictions as well as overestimates on both sides as reasons for slower than expected development.

Emphasizing that semicustom ICs will make up half the semiconductor business by 1990 (see "Wyle's Timmins has designs on ICs," above) Wyle's Clough is perhaps the most ardent supporter of the move to chip design. The market, he says, could be worth as much as \$14 billion by the end of the decade.

"If I'm wrong, if there is a risk, and if there is a doubt, then the future of distribution is pretty dim because the market's going that way," observes the former

marketing vice president at Texas Instruments

"If you look at the basic function of a distributor, what does he do?" asks Clough. "What he does is he brings technology, be it something as simple as a resistor or as complex as a MSI circuit or as multicomplex as a VLSI circuit, to the user. [Chip design] is another technology that is going to be made available to the user."

Design centers

In early 1983, Wyle's Electronics Marketing Group became exclusive representatives for a line of n- and CMOS standard-cell parts manufactured by NCR Corp.'s Microelectronics Division in Dayton, Ohio [*Electronics*, March 10, 1983, p. 48]—a "marketing engagement" is how Clough describes it. Since then, Wyle and other distributors have begun investing heavily in the computer-aided design equipment necessary to support semicustom chip design. Last year, Schweber Electronics, which ranked third in 1983 industrial sales behind Hamilton and Arrow with \$323 million, pioneered design centers when it became the first national distributor to establish a semicustom logic array program. It currently operates design centers in Westbury; Gaithersburg, Md.;

Bedford, Mass.; Minneapolis; and Irvine, Calif.

Earlier this year, Schweber expanded its semicustom logic line through a venture with American Microsystems Inc., of Santa Clara [*Electronics*, Feb. 23, 1984, p. 56]. James Youmans, Schweber's executive vice president for marketing, believes larger distributors can do a reasonable job with logic array design, but the substantial initial investment effectively eliminates smaller distributors from participation.

"It's a big company's game," agrees NEDA's Toby Mack. "It's been said that there are more design centers than customers," but innovative distributors who fail to enter the design market now risk being left out entirely if and when it emerges. "There are calculated risks and [distributors] know it," he says.

Howard Blumberg, Schweber's vice president of microsystems and logic arrays, puts Schweber's investment so far "in the millions" and adds the firm is now determining how much it will spend over the next five years. Although he says it has encountered some problems with customer understanding of what is involved in gate array design, he adds confidently, "I don't think we're going to have a problem being successful."

Diplomat Electronics Corp., a Melville distributor with \$67 million in sales in fiscal 1984, has committed \$1 million toward its logic array systems using Daisy work stations for in-house semicustom chip design (Fig. 7). According to Mel Kutzin, vice president of technical services and responsible for Diplomat's logic design centers, "I agree that [semicustom chip design] is a technical area and most distributors don't have the technical expertise." But he quickly adds that Diplomat's two operating work stations, with eight more on the way this year, provide the firm with the technical support to deliver prototypes to customers in six to eight weeks.

Design strategies

Clough agrees, at least in part, with Kierulff's cautious semicustom design strategy. "I think the approach some of the other people are taking is wrong," he says. "You can't represent 10 product lines and really do this technical design job that you have to do in this marketplace."

Not surprisingly, Schweber's Blumberg disagrees, explaining that the debate over whether to serve only one supplier or several "has become much less of a dichotomy," particularly since Hamilton-Avnet adopted the same multisupplier strategy. "As our vendors come on line with viable programs, we will attempt to serve them," says Blumberg.

Unlike Schweber and Hamilton-Avnet, Clough says Wyle decided early to go with only one supplier, LSI Logic Corp., of Milpitas, Calif. Emphasizing the need for semiconductor skills, Clough asserts that distributors must form "an association that's a very close one with a major source and a major factory." Wyle's timetable calls for 10 to 15 successful gate array designs in the first year, 10 times that number the second year, and \$20 million to \$25 million in sales in two years just with LSI. "If you take a look at the opportunity that exists in this marketplace, I don't think there's another business in America that offers the opportunity that semicustom circuits do for the amount of investment necessary by the distributor," he concludes.



5. Semiconductors and systems. The basic strategy of Wyle Laboratories is built around semiconductors and systems, explains Charles Clough, president of its Electronics Marketing Group. "We want to position ourselves to be leaders in those two main product segments," he says. Wyle is also active in semicustom design.

An inevitable outgrowth of the rapid changes in distribution is the need for a more technically competent sales force, not only in the design segment but also in components and systems. Expansion of the component user base to include nontraditional buyers has fueled this need, according to Charles B. Smith, senior vice president of components business development at Hall-Mark. His firm has increased emphasis on the technical expertise of its sales force, Smith notes. "An intangible benefit is that the sales force is also better able to serve the more traditional customer base, such as large OEMs, which are well versed in components and applications."

Technical competence

Says Arrow's Stephen Kaufman: "We, and I think all the major distributors, are all working very hard to migrate the skills of our people along with the migration of the technology." Arrow will hire several hundred technically oriented salespeople this year as either technical support specialists or computer products specialists.

"More and more, our salespeople, and those of our competitors, are faced with requests, requirements, and sometimes demands from customers to go beyond the purchasing office and get into the design office," explains Kaufman. "It is our belief that the distributor who is able to do that will have a bit of a competitive edge."

While his firm is seeking to develop a value-added service for small customers, Clough says Wyle is in the process of hiring 11 circuit designers for its gate array design program. He adds that 65% of the 70-member sales force has "very good, strong semiconductor skills on a general basis."

"Over the past years, we have seen distributors upgrade their sales force to become much more technical," concurs Motorola Semiconductor's Dunleavy. By sheer

6. Growing systems business. W. Donald Bell, president of Kierulff Electronics, predicts that distributors and other third parties will sell 30% of all computer-related equipment by 1986. At the same time, Bell is skeptical about distributors designing semicustom ICs.



numbers alone, he continues, distributors are able to reach more customers, thereby providing Motorola with better market exposure.

So far, the industry has coped with the problem of finding technically competent people by luring them away from suppliers. Additional help should be coming from a human resources program established by NEDA that helps bring distributors and prospective employees together. According to NEDA's Mack, Texas A & M University and the University of Illinois are among the six to eight schools now participating in their electronic distribution education program, enabling distributors to recruit students with engineering, managerial, and marketing skills. Ten to 15 companies are recruiting through the program now, he says.

Market share

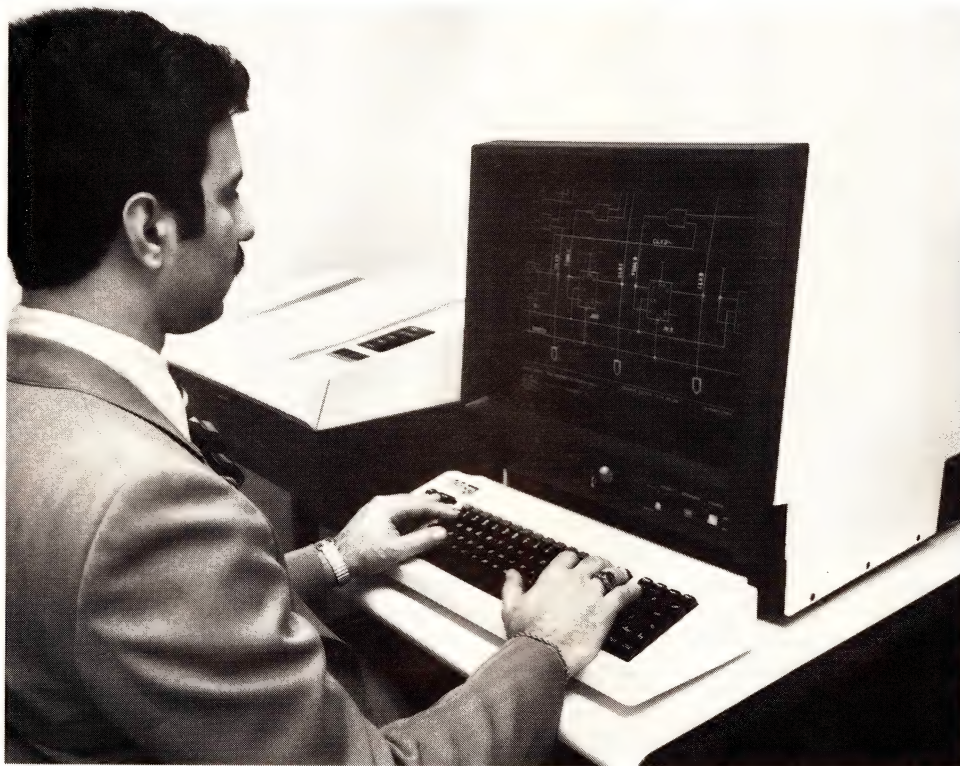
If future directions in the industry seem reasonably clear, the question of how the electronic distribution market will be divided is not. "My belief is that the top 10 [companies] will narrow down to five or six," predicts Kaufman. Along with Arrow, Hamilton-Avnet, and Schweber, Kaufman says Kierulff, Wyle, Hall-Mark, and Pioneer Standard Electronics Corp., Cleveland, will jockey for position.

In the Los Angeles market alone, explains Clough, a customer can buy a transistor or IC from 50 to 60 different distributors. In "the semiconductor business or the applications-specific integrated-circuit business, there will probably be three distributors in this area who will really be able to supply this semiconductor skill that you'll need to be in this business," says Clough, who also predicts a 44% increase in semiconductor consumption during 1984.

Predictably, many of the major players see little room for start-up distributors in either components or the systems business. "I would say that any distributor that wants to go into the business better have a lot of money, and he better have a plan where he specializes in something," observes Hamilton. "You must develop volume in order to support the sales team and the innards of the business to make it reasonably successful."

Dunleavy notes that Motorola franchises a mix of national, regional, and small distributors. But, he adds, "we have made a commitment to go with our nationwide distributors."

Mack agrees that the alternative to a national strat-



7. Designers, too. Diplomat Electronics Corp., in Melville, N.Y., has two Daisy work stations in its logic design centers and eight more machines on the way.

egy is to consolidate, what he calls a "niche strategy." Smaller distributors should carry fewer lines with greater depth or expertise in lines that it would stock more heavily, Mack argues.

Two West Coast distributors that have specialized this way are Marshall Industries, El Monte, Calif., and Cetec, Southgate, Calif. Marshall, which currently ranks ninth among industrial distributors, with sales last year of \$190 million, is the only top 10 company to carry Japanese semiconductors, including Hitachi and Fujitsu. George Tarnewsky, vice president for marketing, says the specialty has helped Marshall but asks, "Does that make us any different from other national distributors? Not really." He emphasizes the firm's 44 other product lines, adding "We do have a proper mix of products."

Cetec Electronics, which projects 1984 sales of \$45 million to \$50 million, also carries Fujitsu and Hitachi, along with Mitsubishi and NEC. Unlike U.S. semiconductor manufacturers such as Intel, National Semiconductor, Texas Instruments, and Motorola, Japanese manufacturers "tolerate each other on national distributors' shelves," says Cetec president Don Cassidy. He says Cetec is competing successfully with Marshall and Times Electronics—part of Hamilton-Avnet's Electronic Marketing Group—among other Western distributors.

But perhaps the newest specialty distributor is a Los Angeles firm called CAL-ABCO [*ElectronicsWeek*, Aug. 13, 1984, p. 29]. Specializing in Japanese ICs, CAL-ABCO has done nearly \$100 million in business since early 1983. The firm maintains a 15-person Tokyo office to ensure a steady supply of the Japanese chips it delivers quickly at a premium price. Suppliers include NEC, Oki, Toshiba, Hitachi, Mitsubishi, and others. Alex Sandel, CAL-ABCO president, says that his firm will continue its unorthodox but successful distribution techniques and resist the more traditional method of seeking exclusive franchises for components.

Geographical expansion and acquisition are likely to be another feature of the distribution industry in the future. For example, in 1981 Hamilton-Avnet acquired peripherals distributor Loonam Associates, now Loonam Computer Products, Minneapolis, in an attempt, chairman Hamilton says, to keep its regular OEM sales force from straying into printer and terminal sales as well as into other end-user accounts.

In the same year, it purchased Sertech Corp., Salem, Mass., to obtain a value-added facility in the semiconductor area. Sertech buys wafers from suppliers complete

with circuits, Hamilton explains, and does special packaging and testing for customers.

A change in the industry that is perhaps less apparent to the outsider is the closer working relationship between manufacturers and distributors. "We are really partners now," observes Kaufman, "we are no longer adversaries. We work together, we share secrets. But as we go forward to design centers, which will link us even more tightly, we will step out from partnership and it might even be marriage."

Common interests

Stephen W. Morgan, assistant vice president for marketing with NCR Corp.'s Microelectronics division, confirms this view: "There's no way suppliers can reach the customer base without distributors." He says distribution in general and the firm's partner, Wyle, have "brought something to the party."

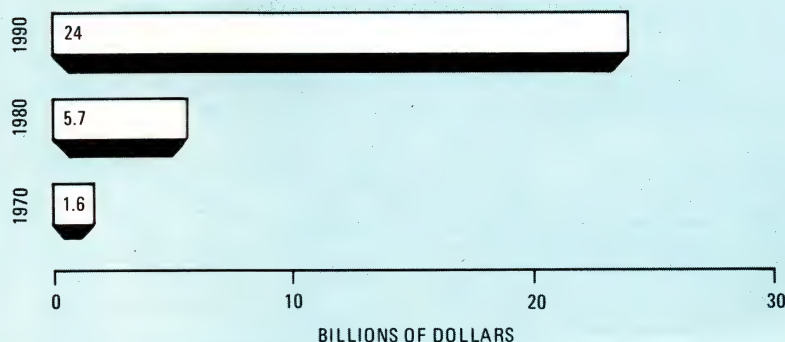
Over the past decade, the relationship between distributors and component manufacturers has matured, with both "appreciating each other in more ways," suggests Hall-Mark's Smith. "Therefore, they are much more concerned and interested about our inventory levels and mix. They want us to have the right products on the shelves at the right time and price."

"They see that they have a common interest," agrees distribution analyst Andrew Neff of Hambrecht & Quist. Because suppliers now tend to franchise fewer distributors, he says, both sides understand one another better. "It depends on whether the supplier views them as an extension of its sales arm or as a customer," Neff concludes.

Powell's Dick Campbell thinks the manufacturer-distributor relationship has improved by virtue of the growing percentage of business going through distribution channels over the past 10 years. "For that to occur," he asserts, "there had to be an improvement."

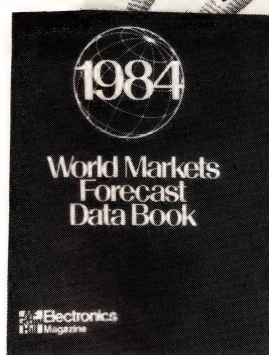
Market growth in the distribution industry (Fig. 8) is expected to continue through the end of the decade, according to Arthur D. Little Inc.'s Meserve. Nevertheless, it appears that electronics distributors aren't planning on relaxing. "The challenge for us, as well as for most distributors with increasing sales, has been the ability to administer our businesses in upturns as well as we did in the downturn," Tony Hamilton observes. "If you don't put [in] orders at the factories, if you don't control your profit centers, it's just as easy to get into difficulty in an upturn as it is in a downturn." □

8. Electronic distribution growth. The most dramatic growth within electronic industrial distribution has been computer-related boards, peripherals, and systems, says Bill Meserve, of Arthur D. Little Inc. By 1990, computers could account for nearly 50% of industrial electronic distribution revenue.



SOURCE: ARTHUR D. LITTLE INC.

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MILITARY ICS MAKE UP FOR LOST GROUND

Digital signal processing and GaAs chips head the DOD's most-wanted list

as the IC market is expected to reach \$2.6 billion □ by Wendy Engelberg

The deployment of high-speed satellite communications systems, smart weapons, and secure communications, command, control, and intelligence systems are among the goals of the Department of Defense for the next generation of military equipment. To achieve these aims, circuit designs will have embedded computers at practically every functional level of military systems.

Incoming data must be processed and acted upon at extremely fast speeds and low power levels. This will require large-scale and very large-scale integration as well as very high-speed integrated circuits to replace older small-scale and medium-scale integrated circuitry, with emphasis on digital processing techniques. Chips to interface between analog and digital circuits eventually will be replaced by digital circuits with on-chip analog circuitry.

DOD making a comeback

All these high-performance semiconductors must operate reliably in a harsh and rugged environment in which radiation resistance will be an important factor. The weapons systems into which they will be designed must be fault-tolerant and jam-resistant. As more capability is packed into each system, demands will increase to make each piece of equipment smaller and lighter, further accelerating the trend toward submicrometer technology.

In the late 1950s, military customers accounted for 70% of the market for the then-budding semiconductor industry. By 1983, this figure had slipped to 11%, as the computer market took the role of dominant customer. Government funding for semiconductor research and development reached a low of less than \$70 million by the 1970s. Now, however, the VHSIC and gallium arsenide IC programs have reversed this trend dramatically; estimated funding for the VHSIC program alone will approach \$700 million through 1988.

The VHSIC program aims to raise

signal processing performance exponentially in an effort to meet the needs of the computer architectures and techniques through the late 1980s and beyond. With the increased use of multiprocessing and application-oriented microcomputers, the chip requirements of the DOD and the industrial and commercial markets begin to merge. The DOD also has earmarked funding for the development and pilot production of GaAs ICs.

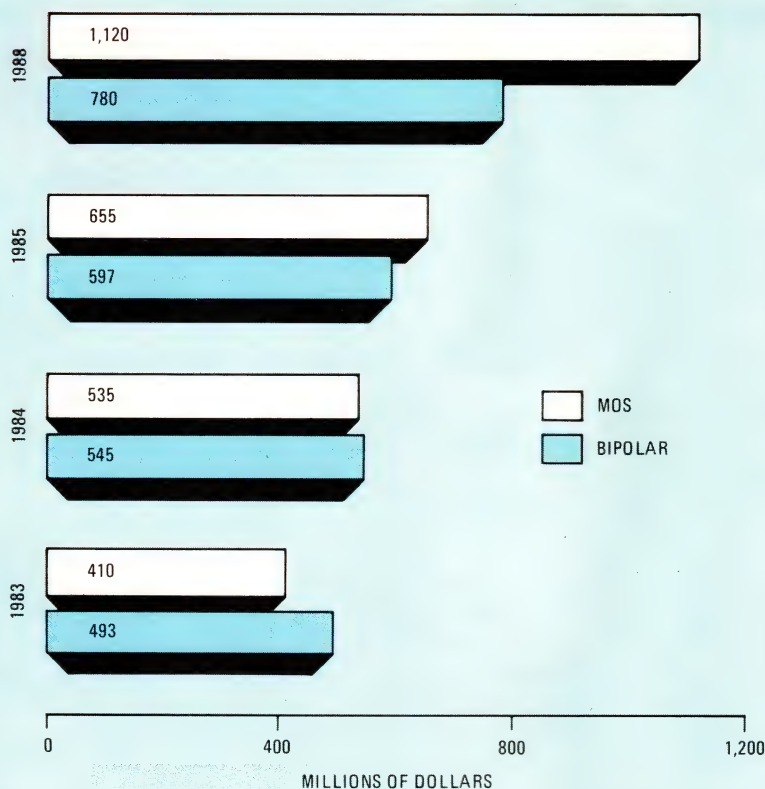
CMOS for DOD

The increased use of complementary-MOS logic and memory in military equipment is another factor in establishing commonality between military requirements and nonmilitary capabilities. The DOD never was fully satisfied with n-MOS technology because of its relatively low radiation-hardness properties when compared with CMOS. GaAs seem to be more radiation resistant than silicon-based ICs, hence the DOD's interest in this technology.

Forecasts for the total military semiconductor market by applications (table) project that it will reach \$2.6 billion by 1988. Growth rates in all applications areas are healthy; signal processing and intelligence applications

U.S. MILITARY SEMICONDUCTOR MARKET BY APPLICATIONS
(MERCHANT SHIPMENTS IN MILLIONS OF 1984 DOLLARS)

Applications	1983	1984	1985	1988
Electronic warfare	187	220	260	420
Signal processing and intelligence	125	160	190	320
Undersea search and surveillance	165	205	235	325
Tactical communications	170	210	245	340
Navigation	70	85	90	120
Training and simulation	70	90	100	145
Radar	210	240	275	425
Other	282	301	342	514
Total	1,279	1,511	1,737	2,609



started from small base figures, but show the greatest growth potential.

Shipments of ICs to the military market according to basic processing technologies (Fig. 1) indicate that MOS circuits will nearly triple in growth through 1988, while bipolar ICs will increase shipments by only 60%.

Growth in the discrete market will be confined mainly to microwave, optoelectronic, and power devices. Power MOS field-effect transistors will experience healthy growth as designers of switching power supplies replace bipolar devices with MOS FETs, whose high-frequency switching properties permit smaller and lighter supplies for airborne and aerospace systems.

Military microprocessors

The military IC field will see an explosive growth in memories and microprocessors (Fig. 2). The increase in storage densities and the introduction of CMOS memories have given strong impetus to this market.

CMOS SRAMs and electrically erasable programmable read-only memories are favored by military designers working on new systems. The integration of EEPROMs in single-chip microcomputers has offered the military designer great flexibility. Their self-adaptive capability is expected to be useful in many military applications where programmability is an important factor, superseding the standard ROMs and PROMs.

A major problem facing circuit designers in military applications is the limited number of microprocessors qualified to MIL-M-38510, which contains detailed specifications for ICs. This means that in many applications, high performance levels can be attained only by selecting

1. CMOS leads the way. The largest growth area in military IC use is CMOS, where the process's low power consumption, high immunity to noise, power-supply fluctuations and radiation resistance are well suited to portable equipment designed for combat.

commercial chips for extensive and time-consuming qualification testing. A major obstacle to military qualifications, however, is the ability of a part to meet radiation-hardness and temperature-acceptance levels.

Until the beginning of the 1980s, most manufacturers pinned their hopes on n-MOS technology for high-speed, high-density logic chips. Only during the last two to three years have commercial producers understood that the power-dissipation limits of n-MOS chips precluded their role as the vanguard technology for VLSI/VHSIC parts. Now many microprocessor manufacturers are turning to CMOS, which not only consumes significantly less power, but has greater radiation resistance than parts fabricated in n-MOS.

The switch to CMOS by commercial suppliers may encourage more of them to attempt qualification testing.

Several producers are coming out with CMOS versions of n-MOS microprocessors.

CMOS may change the attitude of many manufacturers who deem the military market too unprofitable to make the investment in time and money to obtain Joint Army-Navy parts approval. Most attack the military market by offering chips screened to MIL-STD-883B, or whatever level the defense contractor specifies.

The trend toward CMOS is most noticeable in 16-bit microprocessors, which now offer the military-circuit designer the highest level of integration for reliable, general-purpose microprocessors in production. The 32-bit microprocessors still are undergoing acceptance testing and may not make a real impact in weapons systems for at least two to three years.

Digital-signal processing ICs

Military requirements for high-speed and accurate signal processing, added to the advances in VLSI/VHSIC technology, have given further impetus to the introduction of digital signal processing chips. Analog signal processing cannot compete with digital in offering the designer the performance levels needed in the electronic warfare, imaging, and radar applications needed for the next generation of military systems.

Digital signal processing avoids the problems of thermal and externally generated noise that plague its analog equivalents. When collecting, processing, and acting upon incoming data in real time, the military user requires systems with extremely high accuracy and reliability. VLSI/VHSIC digital circuits have high throughput and low power consumption to allow for new architec-

2. Memories expand. CMOS SRAMs and EEPROMs are favorite tools of military equipment designers for applications where programmability is an important factor, for example, where passwords and security codes are changed daily.

tural designs that process such highly complex algorithms as digital Fourier transforms, sampled-data theorems, and complex band-shifting.

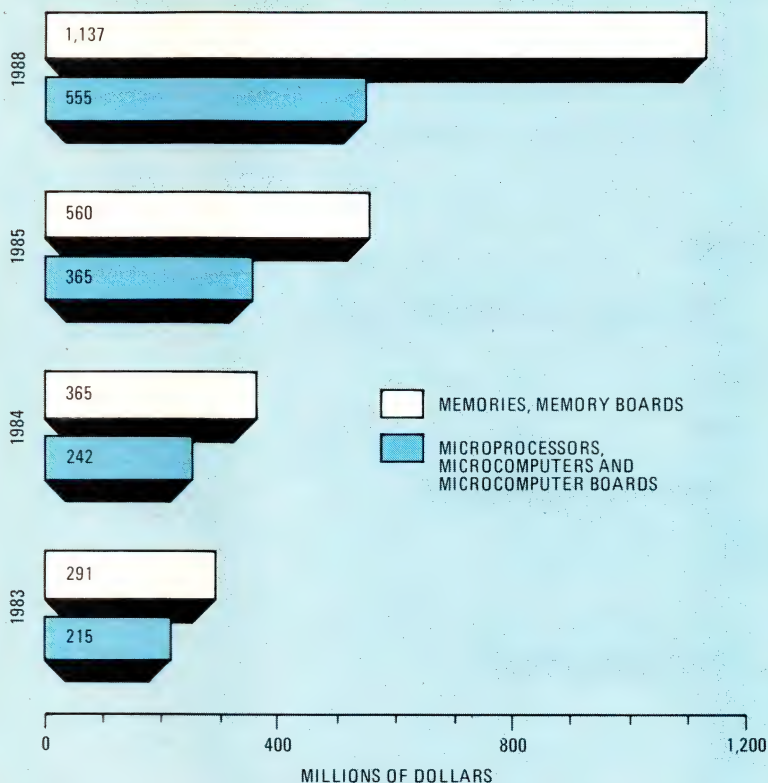
Until the 1980s, digital signal processing chips for military applications were limited in number and manufactured mainly by captive suppliers. In the early 1980s, a number of low-density bipolar Schottky TTL and emitter-coupled-logic chips were introduced into the merchant market. MOS circuits have begun to appear, however, making possible the design of higher-density chips, particularly microprocessors.

While the emphasis in the military has been on n-MOS, it is expected that CMOS will soon take its place in the military market in the same way it has in the commercial microprocessor market. Indeed, shipments of digital and intelligent devices are expected to almost triple, from \$125 million in 1983 to \$320 million by 1988 (Fig. 3).

Leaders in the DSP chip market for military applications include TRW, Advanced Micro Devices, Texas Instruments, and Monolithic Memories. The leaders in analog signal processing chips include Analog Devices and Burr Brown. Bit-slice processors, which have been a popular approach in the past, will be designed into new military systems at a reduced rate since they do not offer the performance capability inherent in high-density microprocessors. Bit-slice architecture will continue to flourish where circuit designers find it expedient to use multiple bipolar chips to achieve high accuracy.

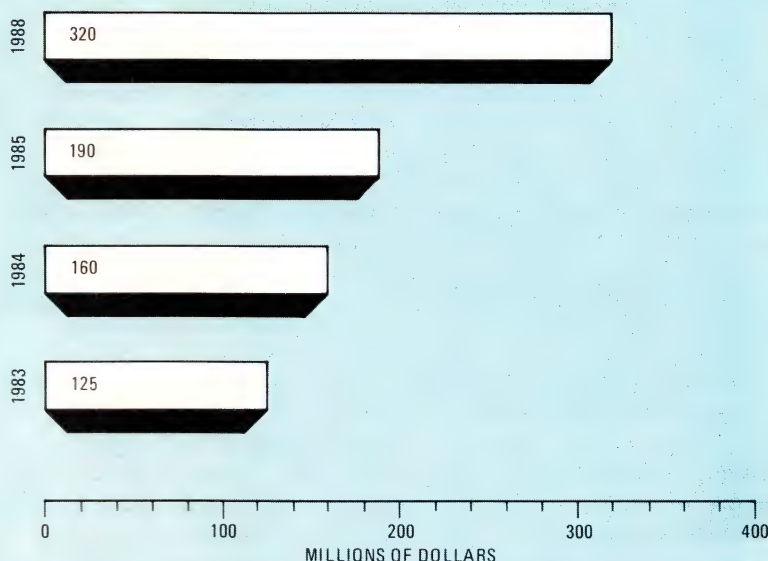
The clock rates necessary to process incoming signals in real time in military environments are beginning to strain the limits of silicon technology; military designers are finding it necessary to extract more speed from silicon logic circuits through new computer architectures. Pipelining and parallel processing are used routinely in new designs and the single-bus von Neumann architecture is be-

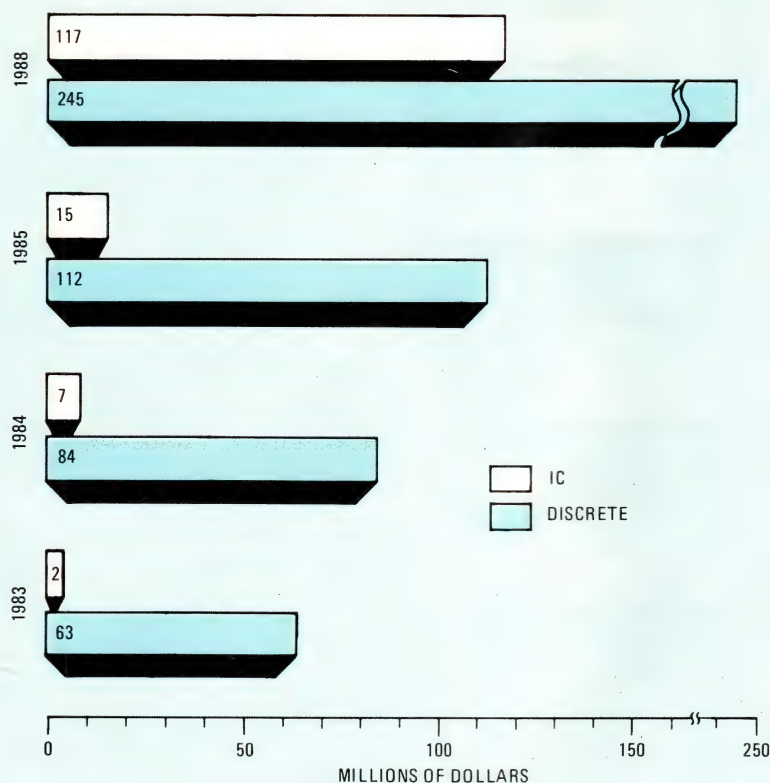
3. Smart chips. Digital signal processing chips, immune to thermal and externally generated noise, which affect analog chips, are high-priority items for real-time computations. Present bipolar versions are being replaced by higher-density MOS versions.



ing replaced by the dual-bus Harvard architecture. Digital chips incorporating the Harvard architecture include a program bus as well as a data bus to allow overlapping of operations during instruction fetching and execution. Voice synthesis and more accurate image processing are some of the benefits of this distributed multiprocessing.

Although silicon structures dominate the semiconductor field, designers recognize that silicon may be ap-





proaching its performance limits in the military market. Certain applications now include requirements that exceed the intrinsic speed capabilities of silicon chips. High-speed real-time digital signal processing, such as used in satellite communications, may not be possible with silicon ICs.

GaAs on the horizon

The constantly increasing irradiating environment of the combat arena has also strained silicon's radiation-resistance capabilities. The increased use of light transmission has exacerbated the inherent inability of silicon to integrate optical and electronic functions on a single chip. Limitations in operating temperature also rule out silicon in some military applications.

On the other hand, a great deal of development time and money has been poured into silicon circuitry during the last 20 years and thus it will be difficult for any other semiconductor material to replace it quickly. However, for an increasing number of applications in the military market, designers will turn to intermetallic semiconductors to be used as a complement to silicon circuits. The leading challenger is GaAs.

GaAs logic and memory chips will begin to have a major impact in the military market by the end of the 1980s (Fig. 4). GaAs-compound chips will have their major areas of growth in optoelectronics as well as in microwave and mm-wave applications. The inherent properties of GaAs, particularly its speed and power characteristics, make this intermetallic compound a preferred material for achieving real-time signal processing in harsh military environments. Contractors developing

4. GaAs gases up. Gallium arsenide logic and memory circuits will find their way into military gear by the late 1980s. Their current growth stems from optoelectronic, microwave, and mm-wave applications. The market for GaAs parts will hit \$362 million.

GaAs logic devices include TI, TRW, Harris, Rockwell, Lockheed, Honeywell, and Hughes.

Semiconductor logic has experienced a rapid growth in the 1980s, primarily because of recent advances in computer-aided design coupled with the advent of high-density circuits, which allow designers to place entire systems on a smaller number of chips. A military systems house may find it more cost effective to use wholly customized chips when its IC requirements are high; for medium-size purchases, the standard cell approach seems the most desirable. When chip volumes are low, gate arrays are preferred. The unit volumes at which each of these three design approaches is most cost effective cannot be pinpointed precisely.

In addition, each vendor offers different quantity cut-off points depending upon his particular product line

and its feature size. As feature sizes diminish, there should be a general shift upward in volume levels as gate arrays cut into standard cell markets and standard cells into wholly custom markets.

Currently, the generally accepted range for gate arrays is from 1,000 to 10,000 units, and 10,000 to 50,000 for standard cells. As gate arrays advance into the VLSI era, it is possible that its upper level of cost effectiveness may peak at 50,000 or even 100,000 units.

The gate array has been part of the military IC design picture for almost as long as silicon ICs; the Air Force funded the development of TTL arrays in the 1960s. Originally, gate arrays were designed in bipolar technology with the most common design approaches being integrated injection logic, ECL, and TTL. TTL, which is the oldest design, is now generally found in the Schottky version.

The most mature of the MOS processes is p-channel MOS, which is now largely being supplanted by newer technologies. The current trend is to CMOS because it offers lower manufacturing cost and lower power dissipation than bipolar chips, as well as speed approaching that of chips made with the rival process.

On the other hand, bipolar chips are making advances into VLSI densities. But the general acceptance by military designers of CMOS has made it the leading technology for gate array logic, and many gate array vendors that surfaced in the 1980s have opted for CMOS as their lead technology. □

Wendy Engelberg is managing director of public relations at Frost & Sullivan Inc., New York, N.Y.

ONE INSTRUMENT SYNTHESIZES TWO SIGNALS

Entire racks of equipment can be replaced by a single synthesizer that generates independent or coordinated signals at frequencies from dc to 13 MHz □ *by Steve Zollo*

Previously, generating complex test signals—such as two-tone, calibrated phase offset, test, or modulated—required two or more sources, an external combiner, a phase meter, and a phase-lock system. The HP 3326A, however, handles applications that require two sources from dc to 13 MHz all by itself.

The HP 3326A eliminates the problem of generating complex signals by combining two independent synthesizers, flexible modulation, and control circuitry into one instrument. The two-channel synthesizer provides two independent signals, two signals related in phase or frequency, or one combined complex signal. A few keystrokes on the front panel generates two-phase, two-tone, pulse, and frequency-hopping signals. Swept signals are greatly simplified, thus providing more versatility in a synthesized source.

The instrument's core is two independent synthesizers, channels A and B; each produces sine and square waves from dc to 13 MHz with independent control of amplitude and dc offset. The key to synthesizing the signals is a technique called fractional frequency synthesis. Using these two sources as a starting point, the 3326A can generate high-performance signals that address needs in two-phase, two-tone, complex-signal, and automated-test-equipment markets.

For example, vital to ATE applications is high-speed spot-frequency testing, which the 3326A's discrete sweep capability makes available. With discrete sweep, the user can define up to 63 frequencies in any random sequence. The user can set not only the frequency of each channel but also the dwell time before moving to the next frequency. Each frequency is phase-continuous, and dwell times can be selected independently from 5 ms to 1,000 s. Discrete

sweep can be used in single or continuous sweeps with all waveforms.

The HP 3326A provides programmable, calibrated, and adjustable phase performance for one-, two-, or multiphase signals. Precision two-tone signals can be generated either on separate channels or combined in one. Its frequency offset tracking, internal-signal combining, and amplitude-control capabilities make possible -80 dBc harmonic distortion for signals with frequencies below 200 kHz. These signals are typically 10 dB better than those that had been available from a programmable synthesizer, the company claims. The synthesizer also produces rapid, sequential signals for dual-tone multifrequency applications.

In pulse mode, the two channels are complementary pulse signals with 15-ns rise and fall times and pulse widths adjustable with accuracy to within 1% of the



period. Pulse signals for digital testing, sweep capability for device testing, and modulation for simulating a variety of complex signals are examples of other applications for the 3326A.

Available 10 weeks after ordering, the HP 3326A is priced at \$9,500. An optional high-stability frequency reference, which provides improved frequency stability for automated testing applications in particular, is available for \$650. There is no charge for a rear-panel signal output for ATE. A second option, high voltage for 40-V peak-to-peak amplitude range below 1 MHz, goes for \$300.

Hewlett-Packard Co., Inquiries Manager, 1820 Embarcadero Rd., Palo Alto, Calif. 94303 [Circle reader service number 338]

Module lets PROM burner do mass programming

A generic gang personality module for 24- and 28-pin MOS programmable read-only memories is now available for use with the M980 or M910 PROM programmer control units. When they are teamed with the PM9082 personality module, the M980 becomes the system 92, for use by engineers who require a control unit for initially writing lines of code in a PROM, and the M910A becomes the system 93, for production duplication of PROMs.

In either case, the PM9082, which can program eight PROMS simultaneously and in parallel, can be configured to program 5-V MOS PROMs by plugging in one of several gang configurators. It has eight sockets, arranged in two banks of four sockets each, to accept the PROMs to be programmed. Each bank has separate current-limited supply voltage and programming voltage regulators. After reset, or when the selected function is finished, the supply voltage is reduced to less than 0.6 V. This cold socket condition is necessary to prevent damage to some erasable PROMs.

The gang configurators are available for most 5-V n-MOS or H-MOS EPROMs. Verification is sequential and compares each PROM independently against the data source through a high-speed verify circuit.

The system 92 is offered in two buffered versions with either 32- or 64-K bytes of random-access memory buffer for \$3,990 or \$4,740.

The system 93 comes in both the buffered and unbuffered versions. The 32- and 64-K-byte buffered versions are intended for use as peripheral programmers, as they can accommodate program downloading from a computer (with the optional communications adapter) and gang duplication from the buffer. The unbuffered version is a one-button master-to-copy duplicator aimed at meeting production requirements.

The unbuffered system 93 with no communications adapter sells for as little as \$2,890. The buffered versions, with the communications adapter and either 32- or 64-K bytes of random-access memory, go for \$3,550 and \$4,290.

Pro-Log Corp., 2411 Garden Rd., Monterey, Calif. 93940.
Phone (408) 646-3677 [Circle 339]

Personal test tool aids 6502 system development

Engineers can use this portable, stand-alone in-circuit emulator as a personal test tool for developing, testing, and maintaining 6502-based hardware and the software written to run on such machines. The DA6502-B costs less than \$600, far below the cost of comparable units, the company claims.

The DA6502-B can support and service systems in a variety of applications—from software and hardware development through production testing, training, and troubleshooting. The 6502 microprocessor can also be found in personal computers produced by a number of manufacturers, including Apple, Commodore, and Franklin.

Measuring 6¼ by 7½ by 3½ in. and weighing under 2 lb, the DA6502-B consists of a terminal, keyboard, display, emulator logic and program, a 6502 processor, a bus switch to connect and disconnect the emulator to and from the user system, and a power supply. Its 24 functions can be invoked with one or two keystrokes.

The emulator accepts simple hexadecimal data and address entry, has an integrated display, and provides simple increment and decrement through memory. In addition, it allows real-time operation of user systems. Some of its uses include examining and modifying random-access memories, input/output ports, and 6502 registers, and examining read-only memories and programmable ROMs.

The emulator is available in 30 days. Quantity discounts are available.

Da-Tech Corp., 92 Steamwhistle Dr., Ivyland, Pa. 18974.

Phone (215) 322-9410

[Circle 340]

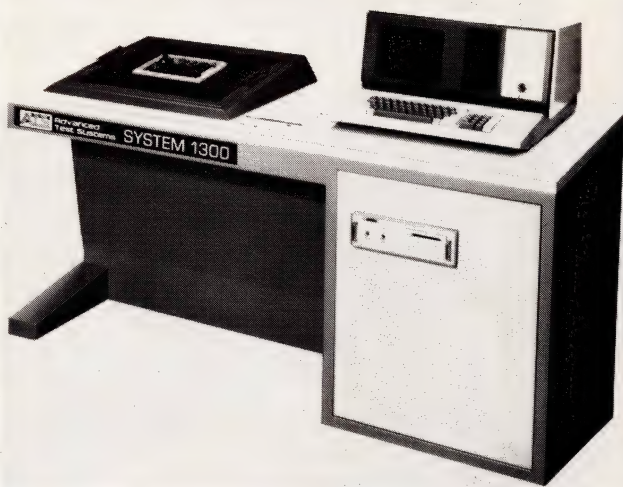
Tester locates problems with components on boards

A production faults tester, the ATS 1300, detects printed-circuit board failures associated with parts selection and workmanship, such as short and open circuits and missing, wrong, improperly inserted, and out-of-tolerance components.

The system features a guarded measurement capability that permits the isolation of the component under test from the effects of shunt impedances. An automatic program-generation feature eliminates the need for time-consuming programming—component values are learned from boards known to be good. In addition, a software-masking feature accommodates pc-board design changes without the need for generating new programs for revisions.

The ATS 1300 software generates a variety of test reports and prints them on a 24-column skip printer. The message includes the type of failure and identifies the faulty component. The basic system consists of a desk console containing the measurement electronics, memory, and switching network. Its operating program is stored in erasable programmable read-only memory.

A 9-in. monitor and a 5¼-in. floppy-disk drive are also included. The basic configuration is priced at



\$39,900; delivery takes up to 45 days after receipt of order.

Advanced Test Systems, 2081 Business Center Dr., Irvine, Calif. 92715. Phone (714) 851-9240 [Circle 341]

System simplifies tests of phase, power, ac in ATE

A line of IEEE-488-compatible test-equipment components designed to simplify phase, power, and ac measurements in automatic test equipment includes three fast-Fourier-transform-based instruments. The system is available in three versions: the model 3100 Sampling Network Analyzer, the model 3105 Power and Harmonic Analyzer, and the model 3110 Precision Wide Band Phase Angle Voltmeter.

All three versions of the equipment have been designed to serve as building blocks in linear ATE systems. Each unit is preprogrammed to provide up to 14 measurement parameters, including impedance, admittance, amplitude, harmonics up to the 50th, phase angle, and frequency. These parameters cover a frequency range of 1 Hz to 500 kHz with accuracies of up to 0.05% and 0.03°. According to the company, tests can be reconfigured by simply reprogramming the unit.

Intended for computer-controlled systems, the 3100 series includes an IEEE-488 interface with a built-in interpreter mode that lets the master computer issue single mnemonic commands.

The base prices of the models 3105 and 3110 are \$13,750; the 3100 is \$12,500. The products are available within 60 days.

Dranetz Technologies Inc., 1000 New Durham Rd., CN-91, Edison, N.J. 08818.

Phone (201) 287-3680

[Circle 342]

Communications interface expands 8050's capability

A version of the 8050 microcontroller offers expanded communications capability through a built-in, three-wire serial communications port. The NS8050U uses an ex-

panded 8048 instruction set with three input/output pins that are assigned to the Microwire Plus interface for local networks. This configuration allows serial communication between two or more NS8050Us or between an NS8050U and the company's line of Microwire peripherals.

The interface lets serial data be exchanged with only three wires through a serial input/output port that is essentially an 8-bit clocked shift register. Three pins on the standard 8050 have taken on secondary functions to accommodate the Microwire Plus. By resetting the system, the NS8050U can be returned to its normal operating mode.

For Microwire Plus applications, one NS8050U must be designated a master, which supplies the system clock signals and initiates all data transfers taking place with one or more slaves. A slave can be any Microwire peripheral or another NS8050U.

Available now, the model NS8050U, priced at about \$4.85 each in orders of 10,000 pieces, comes in both 6-MHz and 11-MHz clock speeds, and for both 0-to-70°C and -40-to-+85°C temperature ranges. The model NS8040U is a ROM-less version; a 6-MHz version sells for \$6.70 each in 100-piece quantities.

National Semiconductor, 2900 Semiconductor Drive, Santa Clara, Calif. 95051.

Phone (408) 721-5000

[Circle 343]

Two chips fill in for 8051, 8031 microprocessors

Due to shortages of the 8051 and 8031 microprocessors, Rockwell International has introduced two others to serve as replacements. The two microprocessors, with 40- and 64-pin configurations, have 4-K read-only memories instead of 3-K ROMs. The R6500/15, with 40 pins, has a configuration similar to that of the 8051, while the R6500/16 affords 24 output/input lines more than the 8051 and its R6500/15 counterpart.

The chips also include 192 bytes of random-access memory, universal asynchronous, receiver-transmitter serial communication, two 16-bit counters, six external and four internal interrupts and 20-mW standby RAM power. They are identical to the R6500/11 and R6500/12, except that they have 3-K ROMs.

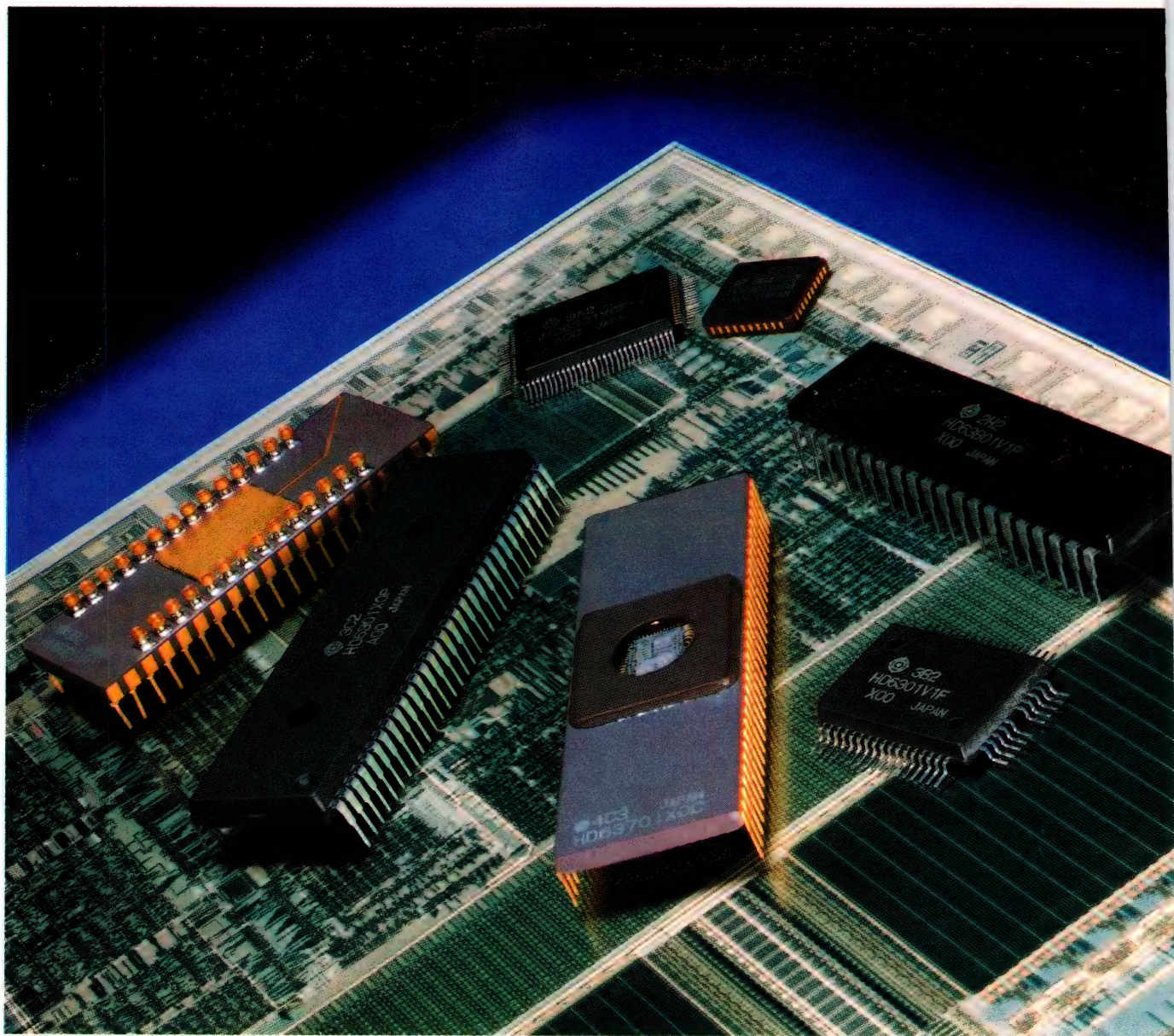
Replacing the company's ROM-less 8031 is the R65010, which has 192 bytes of RAM instead of the model 8031's 128 bytes. Standby RAM power is 20 mW compared to 100 mW, and six internal interrupts as opposed to only three for the model 8031. It can address up to 64-K bytes externally, and still provide 30 I/O lines; or it can address up to 16-K bytes of external ROM or RAM and provide 32 I/O lines.

In quantities of 10,000, the microprocessors range in price from \$4.70 for the model R6500/15 to \$13.70 for the model R6500/16. All are available immediately from stock.

Rockwell International Corp., Semiconductor Products Division, 4311 Jamboree Rd., P.O. Box C, Newport Beach, Calif. 92660.

Phone (714) 833-4538

[Circle 344]



With Hitachi's own CMOS process technology as a base, the HD6301 family of microcomputers has grown to include this broad range of products—specific devices to meet your specific needs.

GOOD NEWS FOR CMOS MICROCOMPUTER
USERS—THE HITACHI HD6301 FAMILY
HAS JUST BEEN

EXPANDED

You are probably already aware of Hitachi's Mask ROM type HD6301V, the single-chip microcomputer with a 4K-byte ROM and 128-byte RAM. It is superior to equivalent NMOS devices in operating speed, as well as in power savings, noise immunity, and suppression of junction temperature rise. Now greet the newest member of the Hitachi series, a higher-capacity model with an EPROM on-chip for exceptional programmability and utility.

Introducing the User-programmable HD63701X

First Hitachi developed a new version Mask ROM type HD6301X to expand RAM space to 192 bytes. Then our engineers added a 4K-byte EPROM on-chip, sealed in a window-fitted package, for easy erasability of contents via UV eraser. The result is the HD63701X, with four timers, a serial interface, I/O ports and the capacity for repeated reprogramming.

The microcomputer section of this powerful unit was designed using Hitachi's own 2.0-micron CMOS process technology to attain a minimum execution time of 0.5 μ s during 2 MHz operation. For high flexibility, it features 53 I/O ports in the single-chip mode and 24 ports in the expansion mode, plus programmable baud rate, expandable bus interface with memory ready and HALT functions, and two power save modes—sleep and standby.

The EPROM section allows addressing through ports 1 and 4 and direct data-writing in the ROM through port 3. It is also possible to write in the EPROM by using a 64-to-24-pin conversion adapter and a conventional PROM writer.

So the new HD63701X can be made available for a wide variety of system configurations and such applications as office automation equipment, personal computer terminals, communications equipment, printers, and related products.

Coming Next: A 16K-byte CMOS MCU

Following the trend toward greater capacity set by the Mask ROM type HD6301X, the very next product in this progressive series is a Y version with a 16K-byte ROM and a full 256-byte RAM. It will be on the market soon, opening new vistas in high-end data-processing, including printers and electronic typewriters with extra-large buffer memories, as well as car electronics equipment.

For more information about Hitachi's complete line-up of CMOS microcomputers, contact your nearest Hitachi representative. You'll see why these devices excel in quality and cost-efficiency, and why Hitachi is known throughout the industry as a leader in high technology and R&D capabilities.



For more information: Hitachi, Ltd., Semiconductor & IC Div., New Marunouchi Bldg., 5-1 Marunouchi 1 chome, Chiyoda-ku, Tokyo 100, Japan. Tel: Tokyo (03) 212-1111. Telex: J22395, J22432, J24491, J26375 (HITACHY), Cable: HITACHY TOKYO
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Hitachi America, Ltd., San Jose Office, 1800 Bering Drive, San Jose, Calif. 95112, Tel: (408) 292-6404, Telex: WU171581, TWX910 338 2103 (HITACHI SNJ)

Compiler improves reliability of C programs

One in a series of products designed to enhance the productivity of C programmers and the reliability of C programs, the Safe C Compiler provides run-time checking of C programs and produces a dynamic trace of function calls with their arguments and returned values. This enables programmers to identify elusive software bugs quickly.

Safe C checks a variety of difficulties that can plague C programmers, such as stray pointers and array indexes out of bounds; it also checks all calls to the standard input/output library. The compiler provides the safety of Pascal—such as the limited built-in error checking—without sacrificing the flexibility of C, according to the company. It does not impose restrictions on the use of C and accepts the same code as an ordinary C compiler.

The compiler monitors a program while it is compiling and executing. A C program that has been compiled with Safe C behaves as if it were compiled by the system's C compiler, with the exception of messages that are written to the standard diagnostic stream warning of potential problems.

Available now for use on many systems, including the IBM Corp. Personal Computer and compatible systems, the compiler ranges in price from \$400 for an MS-DOS version to \$4,000 for a VAX 11/780 version.

Catalytix Corp., 55 Wheeler St., Cambridge, Mass. 02138.
Phone (617) 497-2160 [Circle 345]

Fortran compiler works under MS-DOS, PC-DOS

A version of the SuperSoft Fortran compiler containing large code and data space operates under MS-DOS and PC-DOS. In version 2.0, the company has removed the 64-K code and data space limitation, giving the user as many 64-K code and data segments as desired. The company's Fortran compiler can now be used by those compiling large Fortran programs for microcomputers.

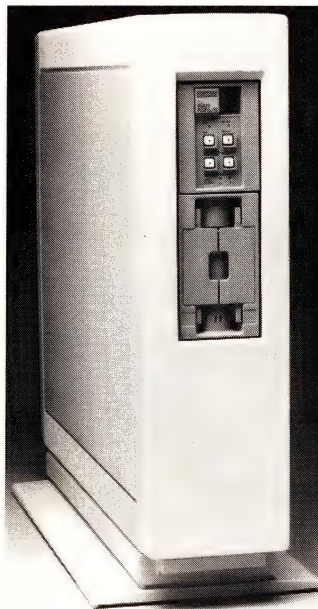
Version 2.0 also follows the Intel Co. format so that the company's Fortran code can be linked easily with code from other microcomputer languages. Version 2.0 runs faster than previous versions, according to the firm, and debugging has been simplified, thanks to an in-line code.

Available now, the compiler is priced at \$425.

Supersoft Inc., P.O. Box 1628, Champaign, Ill. 61820.
Phone (217) 359-2112 [Circle 346]

System uses J-11 processor, performs like minicomputer

A microcomputer whose performance approximates that of a midrange minicomputer, according to its maker, is the second model in the MicroPDP-11 line and incorporates the company's J-11 microprocessor chip set. Applications for the multiuser system include engineering and



communications, as well as office automation.

The system, designated the MicroPDP-11/73, is compatible with all PDP-11 computers and runs 10 operating systems. It accepts Q-bus peripherals, including disks, tapes, and data communication interfaces. Packaged systems that incorporate 31-megabyte Winchester disks and either dual 5¼-in. disks or 60-megabyte streaming-tape-cartridge backup drives are available. For original-equipment manufacturers, a subsystem consisting of a 26-megabyte Winchester-technol-

ogy drive coupled with a 26-megabyte disk drive is also available. For a rack-mount version, the MicroPDP-11/73 sells for \$7,800 and up.

Prices of packaged systems start at \$15,140. The systems are available in 60 days; the company offers quantity discounts.

Digital Equipment Corp., 129 Parker St., Maynard, Mass. 01754.
Phone (617) 264-1669 [Circle 347]

Low-cost multiuser system runs Oasis operating system

A desktop business computer that supports five users, the model MS-1256, sells for \$4,595 and has 256 bytes of memory, 6 serial ports, one Centronics port, and 12 megabytes of unformatted 5¼-in. Winchester disk storage. Another version, the model MS-1256-20, comes with a 20-megabyte disk and sells for \$5,345.

Like the company's Cadet family, the Multi Star computers run the Oasis operating system faster than competing systems, the firm says. Oasis runs a variety of multiuser application programs.

IBC/Integrated Business Computers, 21621 Nordhoff St., Chatsworth, Calif.

Phone (818) 882-9007 [Circle 348]

Powerful multiuser system uses three processors

A microcomputer, the Athena Workcenter, attains a level of performance nearing that of superminicomputers and mainframes, according to the company. The computer uses both the Intel iAPX286 and the Zilog Z80B processors, as well as the the iAPX287 for math coprocessing. The system also provides over 2 megabytes of local no-wait-state memory, several hundred megabytes of Winchester disk-drive storage, an integral streaming tape drive, and a floppy disk drive.

The system, which can be networked, supports many operating systems, including MS-DOS, CP/M, and Unix, plus all the languages, applications, and network protocols to support 24 users simultaneously. Athena, a multiuser multitasking system, runs microcomputer applications up to 12 times faster than an IBM PC XT, the company says. It directly supports 16 million bytes of memory and provides up to 1 billion bytes of virtual storage addressing per user task.

The system is enhanced by an optional floating-point processor designed into the central processing unit. Multiple ports accommodate up to 24 users directly and can be externally expanded. Ports are a combination of parallel, direct-memory access, serial configurable, or other.

Priced at under \$9,500 and available in 90 days, Athena's standard configuration includes 256 megabytes of memory, 21 megabytes of Winchester disk storage, 640-K bytes of floppy disk storage, 4 serial ports, 2 parallel ports, and an intelligent 14-in. terminal.

Spectra Systems Inc., 2754 Compass Drive, Grand Junction, Colo. 81501.

Phone (303) 241-2960

[Circle 349]

Work station is powered by 80188 and Z80A processors

The RamJet personal computer is powered by an internally expandable 128-K central processing unit containing 16-bit 80188 and 8-bit Z80A processors. It comes with MS-DOS 2.11 and CP/M80 operating systems and documentation.

The system has a detachable keyboard that features 90 keys, all software readable, 12 function keys, and a 12-key numeric pad. The RamJet has a built-in Bell 103 modem with auto-dial and auto-answer features. Options include the company's high-resolution color monitor with cabling and a unit that prints letter-quality documents at 120 characters/s. A variety of software will run on the system, including SuperCalc3, Lotus 1-2-3, Wordstar, and other MS-DOS and CP/M packages. Because the system uses standard IBM 2.0 formatting, all files that are created on IBM-DOS and MS-DOS computers are interchangeable.

Available now, the RamJet personal computer sells for \$1,995, retail.

Polo Microsystems Inc., 2570 El Camino Real W., Mountain View, Calif. 94040.

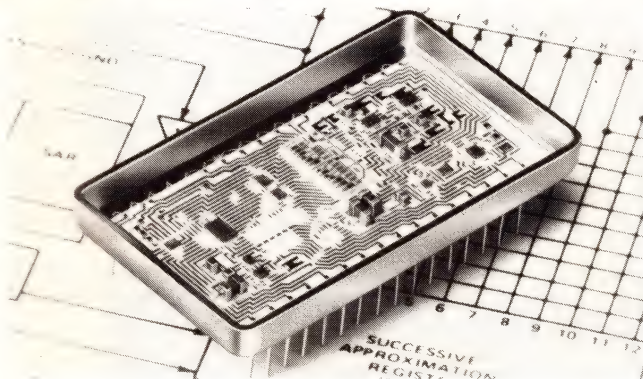
Phone (415) 948-2990

[Circle 350]

Replacement for ADC85/87 operates at higher speed

A successive-approximation analog-to-digital converter, the model ADC-00403, comes in a 32-pin hermetically sealed package and is intended for military and industrial data conversion. It is a pin-for-pin replacement for ADC85/87 types but operates at 2 μ s—a higher speed.

The hybrid device's digital outputs include both serial and parallel output data, and a conversion-status line. Output coding for unipolar input operation is comple-



mentary binary, and coding is complementary offset binary, or 2's complement for bipolar input operation. Other features include a precision internal reference and six pin-programmable unipolar and bipolar input-voltage ranges. Linearity, gain, and offset errors are $\pm 0.1\%$ of full scale and $\pm 0.05\%$, respectively.

Priced at \$169 and \$219 for 0-to-70°C and -55-to-+125°C models, the model ADC-00403 is available from stock in up to eight weeks, depending on the size of the order.

ILC Data Device Corp., 105 Wilbur Place, Bohemia, N.Y. 11716.
Phone (516) 567-5600

[Circle 351]

An 8-bit CMOS d-a converter is flexible, saves space

A monolithic 8-bit complementary-MOS digital-to-analog converter includes an on-chip output amplifier and a double-buffered microprocessor interface to save space and ease the design process. The model AD7224 can operate from a single power supply and accepts a range of input reference voltages, giving it broader application flexibilities than fixed-reference d-a converters, according to the company.

The model AD7224 is made with the company's linear-compatible CMOS process, which allows the high-speed digital logic circuits and precision analog circuits to be integrated on one chip. The double-buffered interface consists of two on-chip registers and digital control logic. The two 8-bit registers—input and d-a converter registers—allow simultaneous output updating in multiple d-a converter systems.

The model AD7224 is available in a 20-pin dual in-line package, and six grades and three package types are available for operation over three temperature ranges. The plastic KN and LN grades are suitable for 0-to-70°C conditions, the ceramic BQ and CQ grades for -25°C to +85°C, and the side-brazed ceramic TD and UD grades for -55°C to +125°C.

The converter requires no user trims, consumes a maximum of 80 W, and is monotonic over the operating temperature range. For single-supply use, the power supply range is 11.4 V to 16.5 V, and total maximum unadjusted error is ± 2 least significant bit for all grades. When operated with dual supplies and a fixed +10 reference, total maximum adjusted error including gain error,

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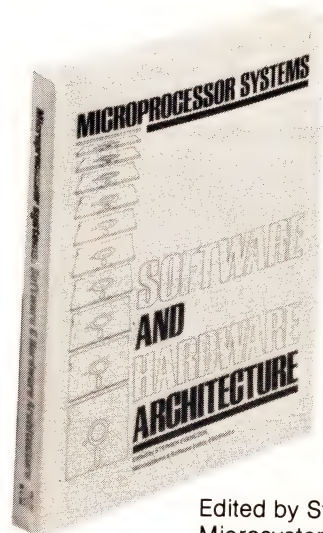
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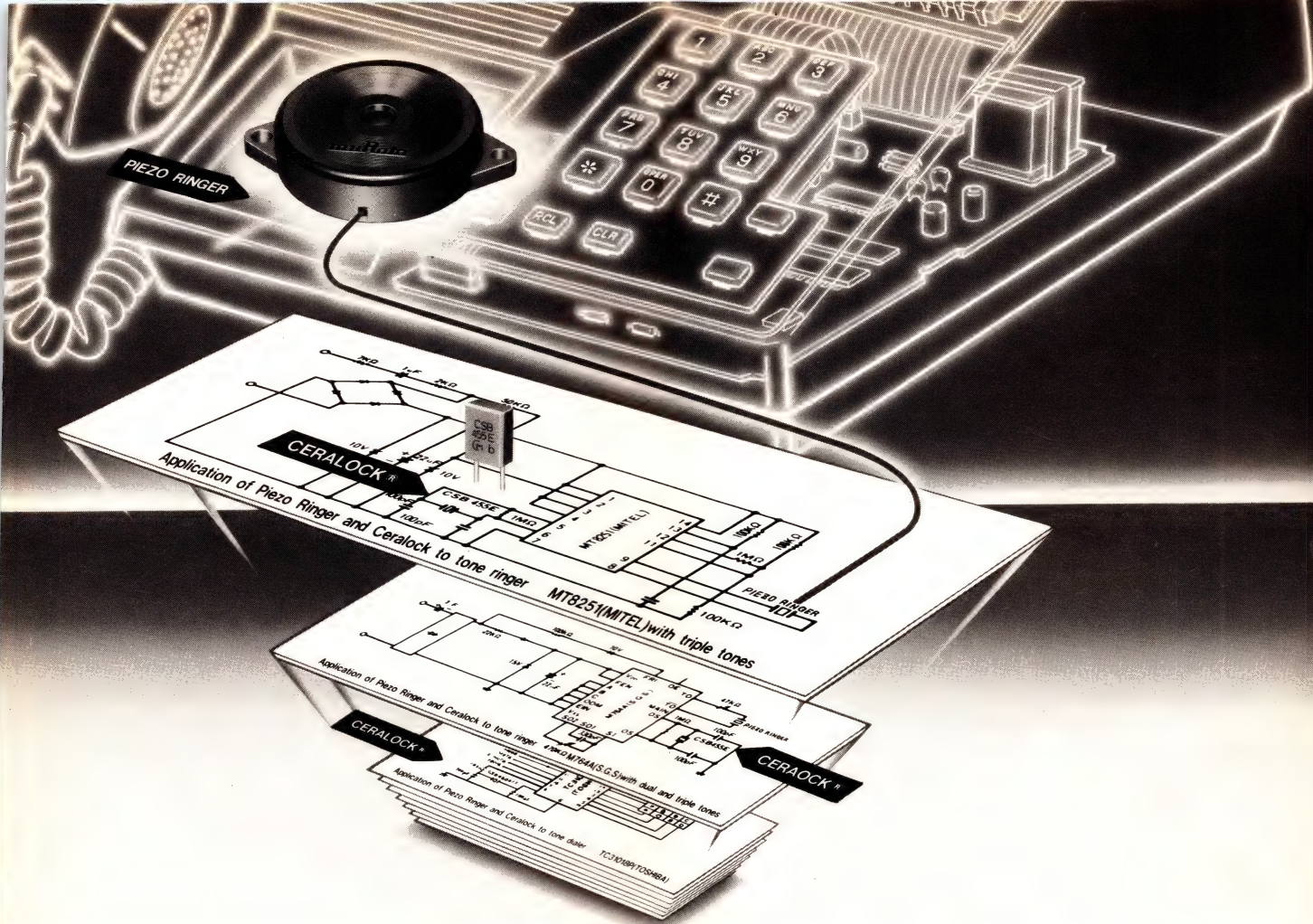
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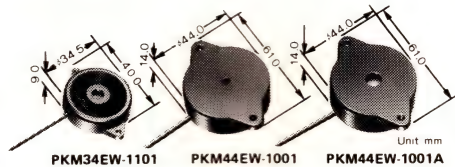
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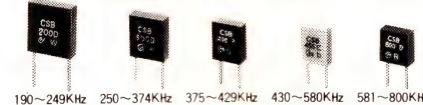


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Ceralock® is available in a wide variety with a reference oscillation frequency range of 190KHz to 30MHz for microcomputers. Each type is compact, lightweight, highly resistant to shock and stable in performance in extreme temperatures. Oscillation circuits incorporating Ceralock®, transistors and ICs need no adjustment. All Ceralock® can be delivered taped and reeled to match automatic insertion specifications.

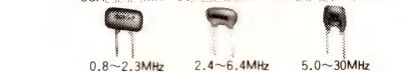
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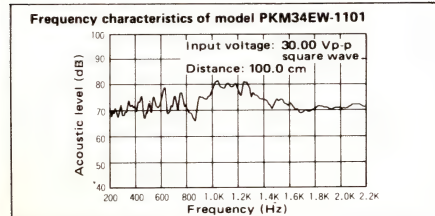
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Car Telephone	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Cordless Telephone	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●



Specifications of model PKM34EW-1101

- Acoustic level: 70 dB min. at 1m, 30 Vp-p, 1.1 kHz square wave
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Circle 105 on reader service card

relative accuracy error and offset error is ± 1 LSB for LN, CQ, and UD grades, and ± 2 LSB for the other three grades.

Pricing for commercial grades starts at \$4.95 each in quantities of 100; delivery takes six weeks.

Analog Devices Inc., Route 1 Industrial Park, P.O. Box 280, Norwood, Mass. 02062.

Phone (617) 329-4700

[Circle 352]

Computer running MS-DOS has five expansion slots

An industrial computer, compatible with IBM PC XT software and hardware, is targeted at large end-user companies and original-equipment manufacturers that are building systems tailored to individual needs. The model ISI 6160 consists of the system baseboard, five expansion slots, a 125-W power supply, and a cooling fan. The system runs MS-DOS and GW Basic, and is compatible with Concurrent CP/M.

The system baseboard has a 4.77-MHz 8088 central processing unit, a socket for a 8087 math coprocessor, 128-K bytes of dynamic random-access memory (expandable to 256-K bytes), a floppy disk controller, two RS-232-C ports, and a parallel data printer port. Because these features are integrated into the baseboard, the expansion slots are free for customization, which can include the addition of industrial input/output, communications, video, or memory. The system includes disk storage consisting of one or two double-sided double-density 5¼-in. floppy disk drives and optional 10-, 20-, or 30-megabyte Winchester disk drives.

The system comes in a standard 19-in. rack-mountable case and is protected by removable dust filters. A desktop case is optional. The model 6160, priced starting at \$2,090, will be available in the last quarter in minimum orders of 25 units.

ISI International Corp., 1275 Hammerwood Ave., Sunnyvale, Calif. 94089.

Phone (408) 743-4300

[Circle 354]

Boards can be configured to control up to six axes

A series of Multibus-compatible numerical control boards designed for manufacturers of factory automation systems incorporate two proprietary complementary-MOS large-scale integrated circuits. The chips can control servo or stepper motors for a range of applications, such as machine tooling, robotics, and plotting.

Models include the NCB-102-2B master board, for control of two axes, and its slave, the NCB-102-3B, for control of one or two additional axes. With expansion modules, up to six axes can be controlled.

For versatility, both linear and circular interpolations can be programmed. An on-board 4-MHz Z80A processor allows high-speed communication between the host central processing unit and the tool or robot under control through a Multibus interface. Control functions include automatic acceleration/deceleration, emergency

stop, and encoder-pulse multiplication.

Available immediately, the NCB-102-2B board sells for \$2,150, the NCB-102-3B for \$1,360.

Toko America Inc., 5520 West Touhy Ave., Skokie, Ill. 60077.

Phone (312) 677-3640

[Circle 356]

Processor-based controller has alphanumeric display



A ¼-in. microprocessor-based controller has an alphanumeric color-coded vacuum fluorescent display that scrolls through selected programs to prompt the operator during system tuning and operation. The front keypad is the operator interface, and the controller has no internal switches, pots, or jumpers to set. All tuning

operations can be controlled through a digital communications option using an RS-232-C, RS-422, or a 20-mA current-loop interface. The model 2000 accepts any thermocouple, resistor temperature detector, or analog input, including process signals.

At a list price of \$399, the system is available now. LFE Corp., Process Control Division, 55 Green St., Clinton, Mass. 01510.

Phone (617) 835-1000

[Circle 355]

Spreadsheet for mainframes is enhanced, easier to use

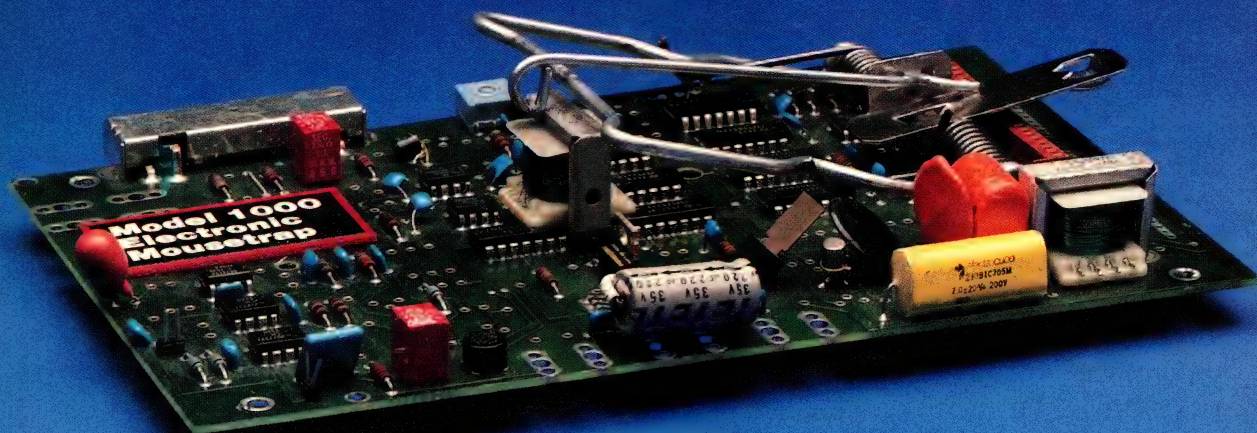
An upgraded version of an electronic spreadsheet for users of IBM Corp. mainframes, called Megacalc, provides menu-driven access to existing non-Megacalc data bases, automated up- and downloading for popular spreadsheets, and expanded on-line help documentation. Megacalc supports XA, the latest version of the IBM operating system MVS.

Users requiring access to existing non-Megacalc corporate data bases can use an expanded Megafile option to read data into the spreadsheet; no programming knowledge is required. The release includes rewritten and improved documentation, including new tutorials and a reference section. The on-line help facility duplicates the hard copy, and when the help key is pressed, the screen describing the last command or function key is displayed.

Over 20 trigonometric, hyperbolic, and transcendental functions have been added, along with new models to the applications library, which include about 75 models for doing cash-flow, forecasting, and regression analysis. Other improvements to Megacalc, used primarily in the TSO operating environment on such systems as the IBM 4300 and 30XX series, include enhanced printing capabilities and reduced loading times and memory requirements. Available now, Megacalc is priced at between

**“If you make a better mousetrap,
the world will make
a beaten path to your door.”**

Ralph Waldo Emerson, 1855



**“If you design a better mousetrap,
the world won't necessarily
make a beaten path to your door.”**

ElectronicsWeek, 1984

In the electronic Eighties industry needs better decisions not just better designs.

Electronics, the world's most dynamic industry, is changing. And Electronics, the magazine that covers the industry, has been changing right along with it.

Ralph Waldo Emerson was wrong.

Better designs are no longer the only keys to success. In the electronic Eighties a company must make better decisions. And they can only be made consistently by industry professionals who are well informed.

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In other words, with the kind of insight that only a classic industry publication like Electronics provides.

More disasters to come?

The bankruptcy of Osborne, and RCA's \$580-million videodisc write-off are just the tip of the iceberg. More possible disasters lie hidden in the future.

And they can only be prevented by decision makers who, regardless of discipline, possess the most complete, accurate and current industry information available.

This is the last issue of Electronics.

JULY 12, 1984

MICROCOMPUTER WORLD NERVOUSLY AWAITS IBM'S PC II/83

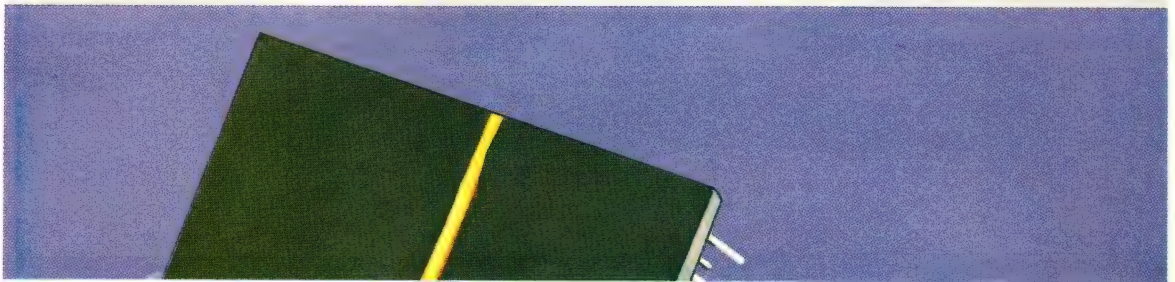
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WORLD MARKETS RIDE A CREST/106



\$15,000 and \$19,000, depending on the size of the user's mainframe computer system.

The MegaGroup Inc., 17701 Mitchell Ave. North, Irvine, Calif. 92714. Phone (714) 474-0800 [Circle 358]

120-tool package simplifies development of software

Consisting of programming aids and more than 120 tools to simplify software development, the Software Development Environment includes features that generate test data and test programs. Others form a facility that tracks changes to programs for auditing purposes, and more than 50 are utility tools that perform such functions as merging, rearranging, and reformatting files, along with printing simple reports.

SDE includes a computer-based course that teaches the user about the system; two modes of operation, one for the novice and one for the experienced user; and on-line help. Also, SDE uses the Pilot language, with which users can develop their own computer-based training courses. A library storage facility may be used as a central repository for source programs.

Available immediately for the company's VRX operating systems, SDE will run with VRX release 9 plus 5 and the Interactive Virtual System. A monthly license for the program is available for \$265 per month.

NCR Corp., Dayton, Ohio 45479.

Phone (513) 445-2075

[Circle 357]

Binary object module support suits processor development

Binary object module support for Intel microprocessor development systems can be used by engineers developing applications for the 80186, 80188, 8086, and 8088 lines. With BSO/FMTCNV, Intel system users can convert symbolic object module files from the BSO format to the Intel format.

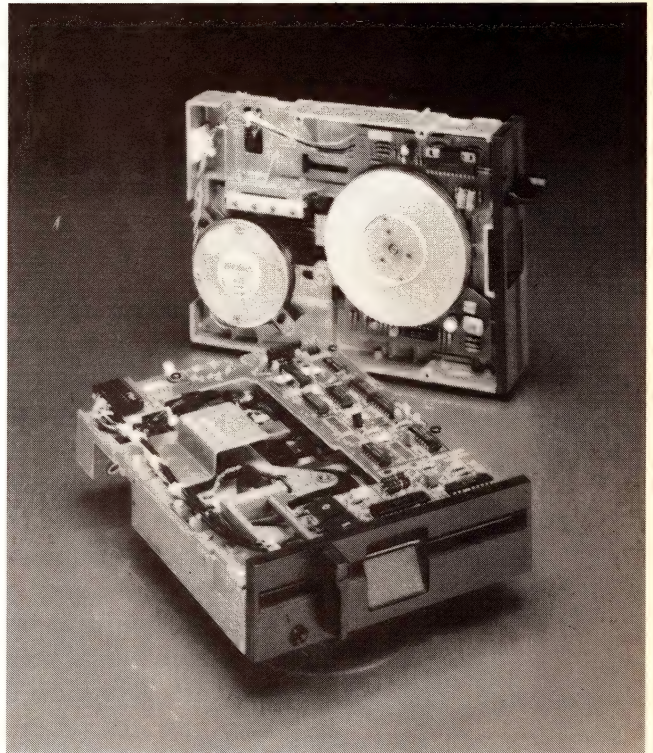
BSO/FMTCNV currently permits the conversion of absolute BSO hex object modules to binary Intel object format modules. Any of BSO's languages, including BSO/C, BSO/Pascal, BSO/PLM, and BSO/Assembly, may be used in conjunction with BSO/FMTCNV. BSO/FMTCNV will operate under a VAX environment under VMS. In subsequent releases, versions will be available for VAX under Ultrix or Unix 4.2 and for the PDP-11 under RSX.

The product, available in one week, is free of charge when licensed with any BSO compiler, assembler, or debugger.

Boston Systems Office, 469 Moody St., Waltham, Mass. 02254. Phone (617) 894-7800 [Circle 359]

Floppy-disk model has ANSI-compatible interface

A half-height 5¼-in. floppy-disk drive with 1.6 megabytes of unformatted memory is equipped with ANSI- and Apple-compatible interfaces, enabling it to work



with industry-standard drives and a range of office, personal, and portable computers.

The model H596-16 comes with bezels that match most industry-standard configurations. A full-height bezel is available to allow placement of a single half-height unit in the space normally occupied by a full-height drive. The drive features a proprietary ball-bearing carriage that achieves high track-to-track positioning accuracy. A continuous band positioner allows a track-to-track access time of 3 ms. A servo-controlled direct-drive brushless spindle motor gives 10 times greater reliability than brush belt-drive motors and guarantees 1% spindle-speed regulation, according to the company.

Available now, the model H596-16 sells for under \$180 each when purchased in large quantities.

Hi-Tech Peripherals Corp., 15192 Triton Lane, Huntington Beach, Calif. 92649.

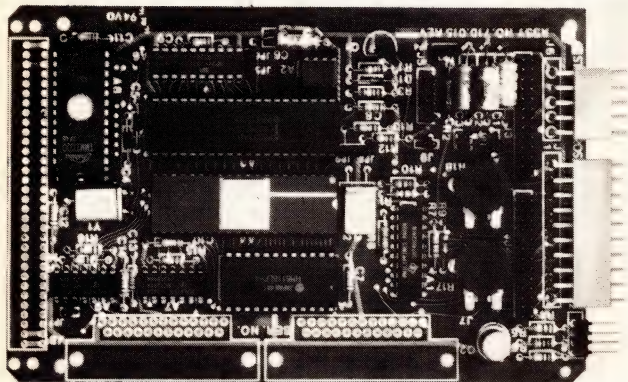
Phone (714) 891-0027

[Circle 353]

LCD-controller builds IBM PC-compatible displays

Based on the CRT 9028 video-terminal logic controller, the Cardinal video-terminal board is a complete nine-chip video-terminal section for makers of microcomputers. The Cardinal, along with a video monitor, power supply, and serial keyboard, will function as a complete video display terminal.

Its features include thin and wide graphics, smooth scrolling, and a menu-driven set-up mode stored in non-volatile memory. The board supports two RS-232-C ports, can operate in both full- and half-duplex modes, and offers both steady and blinking-block cursor.



The Cardinal will drive a monitor with either composite-video or TTL input signals. Built on a single Euro-card, the Cardinal also supports character-by-character attribute selection, parity generation and detection, and multiple baud rates, ranging from 100 baud to 19.2 kilobaud.

Evaluation units of the Cardinal are available now for \$199 each. Production quantities are due in the third quarter. For purchasers of large volumes, the firm will customize the board.

Standard Microsystems Corp., 35 Marcus Blvd., Hauppauge, N.Y. 11788.

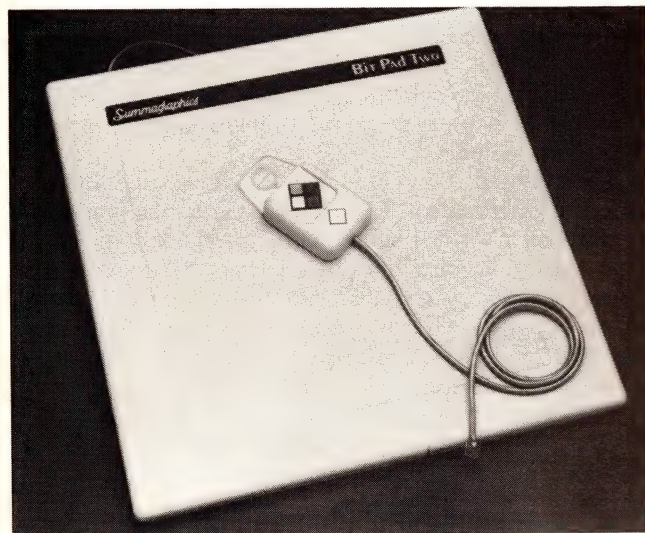
Phone (516) 273-3100

[Circle 362]

High-resolution digitizer is priced at \$640

A digitizer called Bit Pad Two is ergonomically designed, tilt adjustable, and has a flat, 11-by-11-in. work surface for cursor steering, menu picking, and graphic digitizing tasks. Easy integration and electromagnetic technology eliminate the need for periodic biasing. The tablet is plug- and software-compatible with existing Bit Pad One and Bit Pad Ten formats, allowing data tablet capabilities to be changed or increased.

It uses either a three- or four-button cursor or a one-



button stylus with solid-state pen tip and barrel switches, all made interchangeable with a standard telephone connector. Operational requirements are less than 300 mA.

Operational functions such as resolution (up to 1,000 dots per in.), sampling, and baud rates are either remotely controlled from the host or manually selected by different switch settings. Programmable modes include stream, switch stream, remote request, and remote software reset. Built-in diagnostics to check tablet electronics, communications, and transducers are also included.

Conforming to UL, CSA, FCC Class B, and VDE safety standards with testing for electrostatic discharge tolerance, the Bit Pad Two is available immediately and priced at \$640. An optional model is also available with RS-232-C interface.

Summagraphics Corp., 777 State St. Ext., Fairfield, Conn. 06430.
Phone (203) 384-1344

[Circle 369]

Device converts video images to digital data

An interface device for the company's SMC-70 and SMC-70G microcomputers instantly converts video images to digital ones that can be stored on a floppy disk as a computer graphics file. Designed to accept input from any Sony video camera, video tape player, or laser disc player, the SMI-7075 Videotizer can be used in applications involving the processing of color or black and white video images.

With a video camera connected to the Videotizer, existing artwork, pictures, or products can be converted into digital graphics with full color or a full gray scale. Color, hue, and slice-level control are provided. Once a user has digitally stored a video image, it can be manipulated using the Sony Graphics Editor software and labeled with the Sony Video Titler.

The Videotizer is expected to be available in early 1985. Pricing has not yet been established.

Sony Communications Products Co., Sony Dr., Park Ridge, N.J. 07656.

Phone (201) 930-6432

[Circle 368]

Package gives graphics capabilities to Apple units

A hardware/software color graphics package called the Digital Paintbrush System is designed for professional and nonprofessional users of the Apple II+, IIc, and IIe. Its graphics images can be projected as slides on a color monitor or TV screen, printed as hard copy or as transparencies for overhead projection, and photographed to make 35-mm slides.

The hardware, a high-resolution digitizing device, consists of two separate elements: a ball-point-pen-like instrument used as an input device for all functions (cursor control, drawing device, and menu control); and two rotating sensors housed in a plastic case attached to the pen tip by control lines. Movement of the pen is detected by the sensors and interpreted by the software for reproduction of pen movements onto an adjacent computer

screen. The software package consists of six programs including one that enables two people to draw interactively.

The package comes on three small disks, with two back-ups. The four main components are: a graphic design program, presentation program, printout program, and graphics telephone program. Also included is a test-screen editor and an area-measurement program enabling scientists and engineers to digitize and integrate areas.

Available now direct or from retail outlets, the system is priced at \$299.

Jandel Corp., Computer Colorworks Division, 3030 Bridgeway, Suite 201, Sausalito, Calif. 94965.

Phone (415) 331-3022.

[Circle 370]

Uhf push-pull rf transistor is aimed at aircraft radios

Made up of two transistor dice in a single package with independent base and collector leads (but common emitters), the MRF390 ultra-high-frequency push-pull transistor is designed for use in commercial and military avionics radios. The manufacturer says that the 28-V device's push-pull design means lower even-numbered harmonic distortion. Also, says Motorola, amplifier design is made easier because the MRF390 is smaller and less expensive than two single transistors.

The device's output power is 60 W, typical gain is 9.5 dB, and typical efficiency is 55%. Input matching networks give the device a broadband operation of 30 to 500 MHz. Long-term reliability is promised with gold metallization. The MRF390 is available for \$60 in lots of 100 to 499.

Motorola Semiconductor Products Inc., Box 20192, Phoenix, Ariz. 85036

Phone (602) 244-6069

[Circle 365]

Using precise force, tool extracts ICs from arrays

A set of pin-grid array insertion and extraction tools insert and extract pin-grid integrated-circuit packages from sockets, with each tool handling a specific size of pin-grid package. With precision-controlled force, the metal and plastic instrument, called EZ-I/O, handles 10-by-10 through 10-by-18 formatted pin-grid ICs.

Each tool has a precision lead screw to control the extraction forces and uses the shoulder of the socket or the surface of the printed wiring board as a stable lifting platform. The large lead-screw adjustment applies a constant parallel axial force, thus eliminating bent pins and broken ceramic. The large plunger button and pusher block distributes insertion force over the entire surface of the pin-grid package.

The EZ-I/O is available for \$35.65 each when ordered in quantities of one to four and for \$23.75 each in lots of 50.

Augat Inc., Interconnection Components Division, Box 779, Attleboro, Mass. 02703.

Phone (617) 222-2202

[Circle 366]

Machine organizes parts for automatic insertion

A microcomputer-controlled sequencing machine organizes axial lead components for automatic insertion in printed-circuit boards. The Dyna/Pert Entry Level Component Sequencing Machine cuts and dispenses axial lead components from randomly placed lead tape reels and sequences them on a new reel for automatic pc board insertion. It accepts jumper wires through 10-mm body diameter components and sequences up to 10,000 components per hour.

The unit, which accepts components from 20, 40, or 60 stations, can be expanded to handle 25,000 components per hour from 240 stations. The standard setup provides program editing, component sensing, system software and diagnostics; options include a component testing station and expanded memory.

The machine sells for about \$44,000, depending on the number of stations and options, and is available now.

Dyna/Pert, Division of Emhart, 181 Elliot St., Beverly, Mass. 01915. (617) 927-4200

[Circle 371]

Laser-based work station combines many operations

The LPS work station provides precise soldering, welding, or cutting in a single enclosure. Processed materials may include metals, high-performance alloys, composites, and plastics.

Intended for a manufacturing environment, the LPS work station can use various lasers, numerical control machine controllers, and multi-axis positioning systems. The lowest-power version, the LPS-1 with a 20-W carbon dioxide laser, is suited for soldering and wire stripping. An 80-W CO₂ laser is used in the LPS-2, which is suited for soldering and wire stripping, plus Kapton removal and drilling and cutting of plastics. Drilling and spot welding of metals can be performed by the 70J Nd:glass laser, LP-3.

The LP-4 and the LP-5 use either a 150-W or 200-W YAG or the company's proprietary Allexite laser. These two systems are intended for drilling, cutting, and welding of metals; according to the company, the higher power allows processing of thicker material and faster throughput. A separate power supply cabinet is provided with both systems.

The enclosed 30-by-30-in. work area provides a Class 1 working environment. Operator access to the work table is through a vertical sliding door interlocked to prevent laser operation when the door is open. The door has a counterbalance system that can be configured for pneumatic actuation. The work table is positioned for a seated operator, and all system controls, status indicators, and flow gauges are located next to the operator.

With manual control, the process is controlled entirely by the operator. Under automatic operation, the CNC controller can be programmed by the user by way of the keyboard, magnetic tape, or floppy disks.

The LPS work station has overall dimensions of 85 by

61 by 61 by 38 in. and weighs 2,000 lb. Available in 90 to 120 days, the system sells for \$90,000 to \$135,000, depending on the type of laser and accessories.

Apollo Lasers Inc., 9201 Independence Ave., Chatsworth, Calif. 91311. (818) 709-1596 [Circle 372]

Connector shields against emi/rfi in interconnects

A 25-pin metal-faced D-subminiature connector protects against electromagnetic and radio-frequency interference in input/output applications and electronic interconnections. A metal face shields high-frequency radiation that emanates principally from the point of external interconnection.

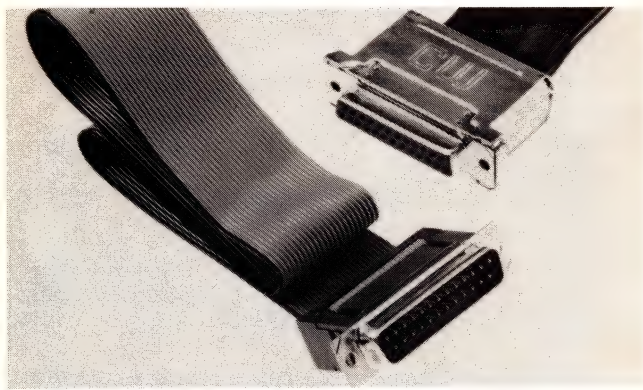
The metal flange/face forms the front of the connector and mates with traditional D-subminiature connections and is designed to applicable standards in MIL-C-24308 and Federal Communications Commission Part 15 regulations. For uses requiring additional emi and rfi protection, a tin-plated metal shield can be added to the metal-faced connector. In laboratory tests, the metal-faced connector encased in the assembled enclosure can reduce stray emissions by up to 80 dB. Both the metal-faced connector and the metal shield are assembled without screws or fasteners.

Priced at \$4.52 each in quantities of 50, the connectors are available within five weeks.

CW Industries, 130 James Way, Southampton, Pa. 18966.

Phone (215) 355-7080

[Circle 361]



A 1.7-g solenoid comes in TO-5 case, handles 24 V dc

A miniature solenoid that fits in a TO-5 transistor case operates on pulse power and includes such features as low energy consumption, high iron resistivity (to limit the slow-down effects of eddy currents), and low hysteresis losses. The TO-5 solenoid comes in any operating voltage up to 24 V dc, weighs 1.7 g, and has wire leads for terminals.

With an operational life that the firm says exceeds 100 million operations, the solenoid also provides a high saturation flux density for magnetic efficiency as well as a

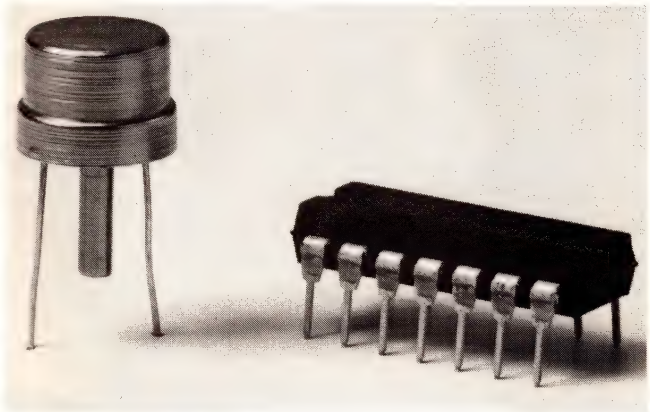
high iron-to-copper ratio to limit iron saturation and for efficiency. Applications include shutters for optical devices, such as cameras, projectors, and lasers, and latch-release mechanisms, such as breaker trips, alarms, and firing gear.

The price for orders of 50,000 pieces is \$1.95 each. The TO-5 solenoid is available within eight weeks.

Line Electric Products, P.O. Box 327, Hartford, Conn. 06141.

Phone (203) 659-3573

[Circle 363]



High-voltage thyristors suit industrial applications

A range of high-voltage fast-switching thyristors are intended for industrial use in motor control, inverters, converters, high-frequency welding, and related applications.

The DK and TF series deliver symmetrical blocking voltage up to 2,000 V, spanning current ratings from 100 to 1,300 A. The units provide turn-off times as low as 40 μ s for blocking voltage ratings of 2,000 V.

The thyristors are priced from about \$44/unit for the low-current models in 100-piece orders; delivery takes up to 16 weeks.

Thomson Semiconductors, Discrete Components Group, 6660 Variel Ave., Canoga Park, Calif. 91303. Phone (818) 887-1010

[Circle 374]

Surface temperature detector has 2-s access time in liquid

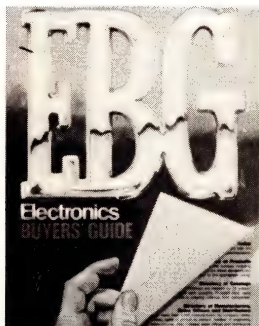
The model TD3A interchangeable surface temperature sensor is a 40-by-50-mil silicon chip onto which a thin-film resistive network has been patterned. The sensing element is mounted in an industry standard TO-220 transistor package for ease of operation, and its response time is typically 2 s in liquid.

The model TD3A, which has an accuracy of $\pm 0.7^\circ\text{C}$ at 20°C , comes without the need for calibration. It provides a sensitivity of 8 mV/ $^\circ\text{C}$ with 1-mA excitation and has an inherently near-linear output. Chips are trimmed to provide 2,000- Ω normal resistance at room temperature. Maximum error is $\pm 2.5^\circ\text{C}$ over the full operating range of -40° to 150°C .

Typical applications for this detector include heating,

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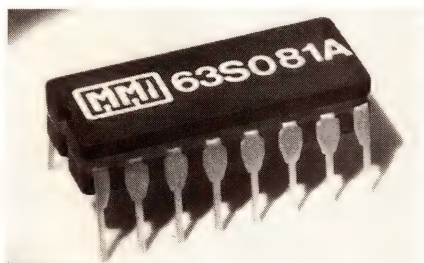
ventilating, and air conditioning, as well as air and oil temperature sensing for automobile engines.

Priced at \$1.09 in large orders, the model TD3A is available from stock for immediate delivery.

Micro Switch, A Honeywell Division, 11 West Spring St., Freeport, Ill. 61032.
Phone (815) 235-6600 [Circle 373]

A 32-by-8 bipolar TTL PROM boasts 15-ns access time

A 32-by-8 bipolar, TTL programmable read-only memory has a guaranteed access time of 15 ns—which gives it an operating speed 40% faster than competing models, the company says. The model 53/63S081A requires a maximum power supply current of 125 mA, and its output



drive capability is 16 mA.

Suited for programmable logic applications that need more product terms than conventional programmable logic array circuits can supply, the model 63S081A will operate side-by-side with fast PLAs to reduce cycle times. On-chip circuitry and Ti-W fuse links in the chip provide pre-programming and testing, ensuring reliability with programming yields greater than 98%, according to the company.

Featuring pnp inputs for low-input current, three-state outputs, and full Schottky clamping, the chip's applications include decoders, lookup tables, random logic replacement, and code converters.

The model 63S081A is available now in plastic or ceramic 16-pin dual in-line packages. In quantities of 100, the plastic version sells for \$2.98 each and the ceramic version goes for \$3.48 each.

Monolithic Memories Inc., 2175 Mission College Boulevard, Santa Clara, Calif. 95050. Phone (408) 970-9700 [Circle 376]

Backplanes reduce prices of DEC-compatible machines

The DSC series of backplanes are a low-cost means of building Digital Equipment Corp.-compatible computers. The DSC backplanes use the company's PDQ press-fit technology so that pins, insulator housings, and connectors can be removed or replaced individually.

The housings also permit the assembly of connectors to any length. Available pin grid patterns include 0.125-by-0.125 in. and 0.125-by-0.250 in. The units are available in custom configurations as well as in 4-by-6 and 9-by-6 systems. They feature a total ground plane on the pin side for noise reduction, a removable plastic protective cover for making power harness connections without disturbing pins, and contact plating of 30 microinches.

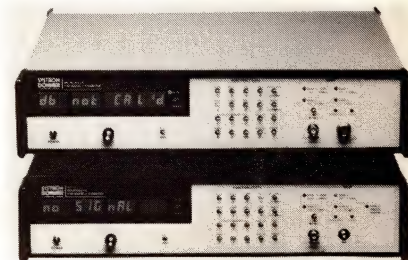
The DSC-DD11-CK four-slot unit sells for \$200; the DSC-DD11-DK 9-slot unit, \$325; and the DSC-DD11 9-slot unit, \$375.

SAE Engineering Products Group, 3520 De La Cruz Boulevard, Santa Clara, Calif. 95050.

Phone (408) 988-0700

[Circle 375]

Microwave counters cover up to 110 GHz, 60 dB



The two model 6000 automatic microwave/millimeter counters offer frequency coverage to 110 GHz and 60 dB of dynamic range with a guaranteed sensitivity of -30 dBm. The 12-digit display models have an optional amplitude-measuring capability for simultaneous display of frequency and power. The same display gives English readouts of the calibration and diagnostic prompts.

According to the company, the counters provide very high a-m/fm tolerance and a standard IEEE-488

MINICOMPUTERS

interface. Model 6020, covering from 10 Hz to 18 GHz, sells for \$5,500; the model 6030 covers from as low as 10 Hz up to 26.5 GHz and sells for \$6,000.

Both models can be delivered 90 days after ordering. Additional frequency extension modules are available from the company.

Systron Donner Instrument Division, 2727 Systron Drive, Concord, Calif. 94518.
Phone (415) 676-5000 [Circle 377]

Cache, floating-point units add speed to Pyramid 90x

Data-cache and floating-point units can double the performance of Pyramid Technology Corp.'s 32-bit AT&T Bell Laboratories Unix-based 90x superminicomputer for specific applications. With the new floating-point unit, the computer adopts the IEEE-754 standard for floating-point presentation. When applications require fast access to arrays and high-speed floating-point operations, the new units expand the range of performance of the 90x system.

The data-cache unit, model 4110, speeds access to memory-resident data structures. It provides 32 kilobytes of fast memory within the 90x central processing unit, in addition to the standard 4-K-byte instruction cache.

Whenever an instruction requires that a data item be retrieved from or stored in main memory, the data cache is checked. If the item is available there, it can be read or stored in less than half the time normally required for access to main memory. If main memory must be accessed, the data item is brought into the cache and is available there for later reference.

The 4110 may be added to any 90x CPU. The IEEE-standard format ensures interchangeability of floating-point data files between Pyramid systems that also use it.

The data-cache unit is priced at \$14,500, and the floating-point one sells for \$8,500. Shipping time is 30 days.

Pyramid Technology Corp., 1295 Charleston Rd., Mountain View, Calif. 94043
Phone (415) 965-7200 [Circle 367]

OKI Announces a New Era in Plasma Graphics



The OKI SS Series of plasma displays offers a new way of communicating complex ideas for industry and the consumer. The flat displays provide a compact alternative to bulky CRTs in personal computers. Fine resolution and elimination of flicker and glare reduce operator eye-strain and fatigue.

Other applications include point of sale and banking terminals, measuring instruments and numerical control machines.

- **SS640400R**
(W 640 dots x H 400 dots: Neon orange)
(Under development)
- **SS480240R**
(W 480 dots x H 240 dots: Neon orange)
- **SS320160R**
(W 320 dots x H 160 dots: Neon orange)

- **SS256128R**
(W 256 dots x H 128 dots: Neon orange)
- **SS192020R**
(W 192 dots x H 20 dots: Neon orange)
- **SS096016R**
(W 96 dots x H 16 dots: Neon orange)

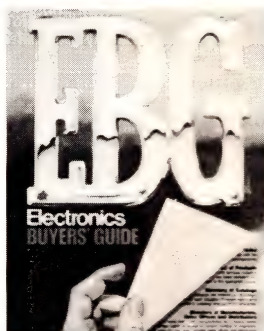


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Materials

Two lines of structural adhesives, one called Scotch-Weld and the other called Pronto, are suitable for high-strength bonding of metals, rigid plastics, wood, and many other materials for electronics and product assembly applications. The Scotch-Weld line includes two film adhesives, six one-part epoxy adhesives, and nine two-part epoxy adhesives. They are available in various container sizes. The Pronto instant adhesives line consists of nine instant-bonding adhesives, an adhesive dispenser, a fluorescent dye, and a surface activator.

All the adhesives in the two lines have varying properties to meet specific high-strength bonding requirements. The one-part solvent-free Pronto adhesives can cure in seconds at room temperature, needing only contact pressure to form high-strength bonds with a wide variety of substrates, including metals, plastics, and difficult-to-bond materials such as rubber and flexible vinyls.

The Scotch-Weld line consists of thermoplastic film adhesives that provide uniform adhesive thickness, controlled confinement of adhesive to immediate bonding area, clean bonding operations, less waste, and simple application (they can be die-cut into complicated shapes). These film adhesives provide 2,000 lb/in.² metal-to-metal shear strength at 75°F. They have a short, 5-min cure time at 300°F. The adhesives are available now.

3M, Adhesives, Coatings, and Sealers Division, 223-1N, 3M Center, St. Paul, Minn. 55144. [Circle reader service number 421]

A series of low viscosity epoxy inks has been developed for flexible circuits and membrane switch applications. The flexible epoxy inks include silver-, nickel-, and graphite-filled conductive resin with resistivity as low as 0.0001 Ω /cm. All the inks are 100% solid with extremely low viscosity for conventional screen-printing operation.

The cured resins adhere well with Mylar and Lexan films for membrane switches and other flexible circuits. The cured inks can be flexed over 180° without delamination, loss

of conductivity (in the case of conductive inks), or loss of dielectric properties (in the case of dielectric inks).

The printed ink, which can be cured at 150°C for less than 5 min or 125°C for 15 min, has a pot life for printing in the range of 16 h at 25°C. The epoxy inks are available now. AI Technology Inc., P.O. Box 3081, Princeton, N.J. 08540. Phone (609) 799-5550 [Circle 422]

A halide-free water-soluble liquid flux has been formulated to meet the requirements of wave soldering and the thinning of dual in-line package leads. The company claims that unlike other water-soluble fluxes on the market today, Hydro-X HF/30 liquid flux provides superior activity without the need for any halide activators.

Halide residues are corrosive and conductive, and therefore must be removed after the soldering operation. Easily removed by water-based cleaning solutions, Hydro-Z HF/30 leaves a noncorrosive halide-free surface. It is available now in 1-quart containers and 2½- and 55-gallon drums. Multicore Solders, Cantiague Rock Rd., Westbury, N.Y. 11590. Phone (516) 334-7997 [Circle 423]

A form-fitting vinyl coating seals and protects electrical connections, feeders, components, fittings and taps, and blocks against corrosion. Liquid Lectric Tape, as it is called, is a dielectric that prevents vibration and resists moisture, oil, grease, gasoline, acids, and pollution. Its use will not interfere with changing connections.

The coating is said to reduce corrosion on outdoor cable connections. Corrosion can affect conductivity of connections (resulting in poor picture and reception), can shorten the life of cable equipment, and can damage line equipment and components.

A 4-oz can with an applicator brush in the cap sells for \$4.95. MDR Corp., 116 Church St., Freeport, N.Y. 11520 [Circle 424]

Curing quickly, the EP51M epoxy resin adhesive offers excellent bonding to polycarbonates and other difficult-to-bond engineering plastics.

The adhesive is a 100% reactive two-component epoxy resin system that bonds readily to polycarbonate, ABS, styrenics, metallic substrates, ceramics, and wood, as well as to other substances.

The mixed epoxy resin compound gels in about 3 to 5 min and cures to full strength within a few hours at ambient temperatures. Bonded parts can be safely handled within 30 to 45 min at room temperature. The company claims the hardened adhesive produces durable high-strength and tough bonds that are resistant to thermal cycling and chemicals in-



cluding water, oil, and most organic solvents, over a temperature range of -60°F to 250°F.

Master Bond Inc., P.O. Box 522, Teaneck, N.J. 07666. Phone (201) 343-8983 [Circle 425]

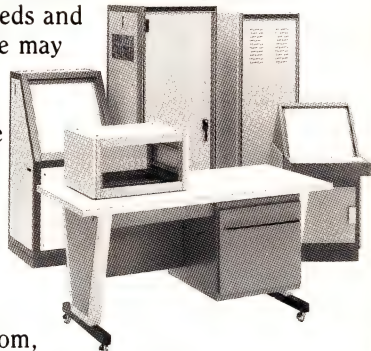
Available now both in heat-treatable and mill-hardened tempers, the beryllium nickel alloy strip No. 360 features good spring characteristics at high temperatures. The material has excellent formability, particularly in the mill-hardened forms and even at high strength levels. It combines excellent strength with a stress relaxation of less than 2% in 1,000 h at 392°F.

Designers can make use of such properties of the beryllium nickel alloy 360 strip as its tensile strength of about 300,000 lb/in.², yield strength of up to 245,000 lb/in.², and fatigue strength (in reverse bending) of 85,000 to 90,000 lb/in.² at 10 million cycles. Overall, the characteristics of beryllium nickel make it highly reliable for spring applications in high-temperature environments such as appliance controls and thermostats. Brush Wellman Inc., 17876 St. Clair Ave., Cleveland, Ohio 44110. Phone (216) 486-4200 [Circle 426]

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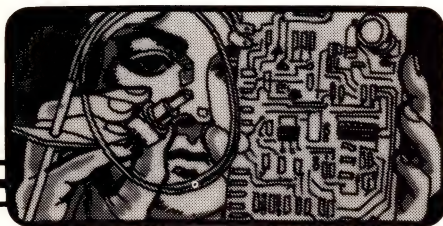
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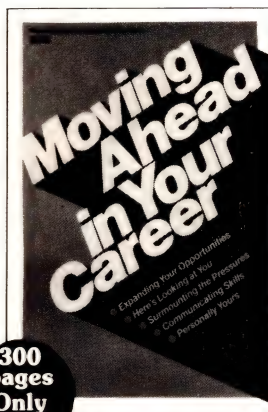
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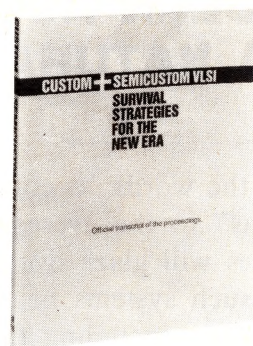
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That interesting thesis, which could be highly significant to electronic equipment manufacturers, has been advanced in a *Harvard Business Review* article by Robert S. Kaplan, former dean of Carnegie-Mellon University's business school and now Arthur Lowes Dickenson Professor of Accounting at the Harvard Business School. The article notes that benefits of new computer-based abilities are being lost because they "rest on a foundation that is obsolete and in need of repair." Thus, even as U.S. companies strive to renew their commitment to excellence in manufacturing, Kaplan

goes on to say that "most companies still use the same cost-accounting and management-control systems that were developed for a competitive environment drastically different from that of today."

This situation is a double-edged sword for the electronics community. For even though it is beset with the same accounting problems as other industries, the electronics industry finds itself in the enviable position of being able to use its experience to provide better electronic solutions to the business community at large. A nascent market, in hardware and software, exists among companies that are eager to install modern accounting systems. With computers and their robot cousins already inexorably entwined with both the office and factory floor, the accounting and control problem thus becomes a natural for the right electronic solutions.

THE BRITISH SET AN AMBITIOUS GOAL

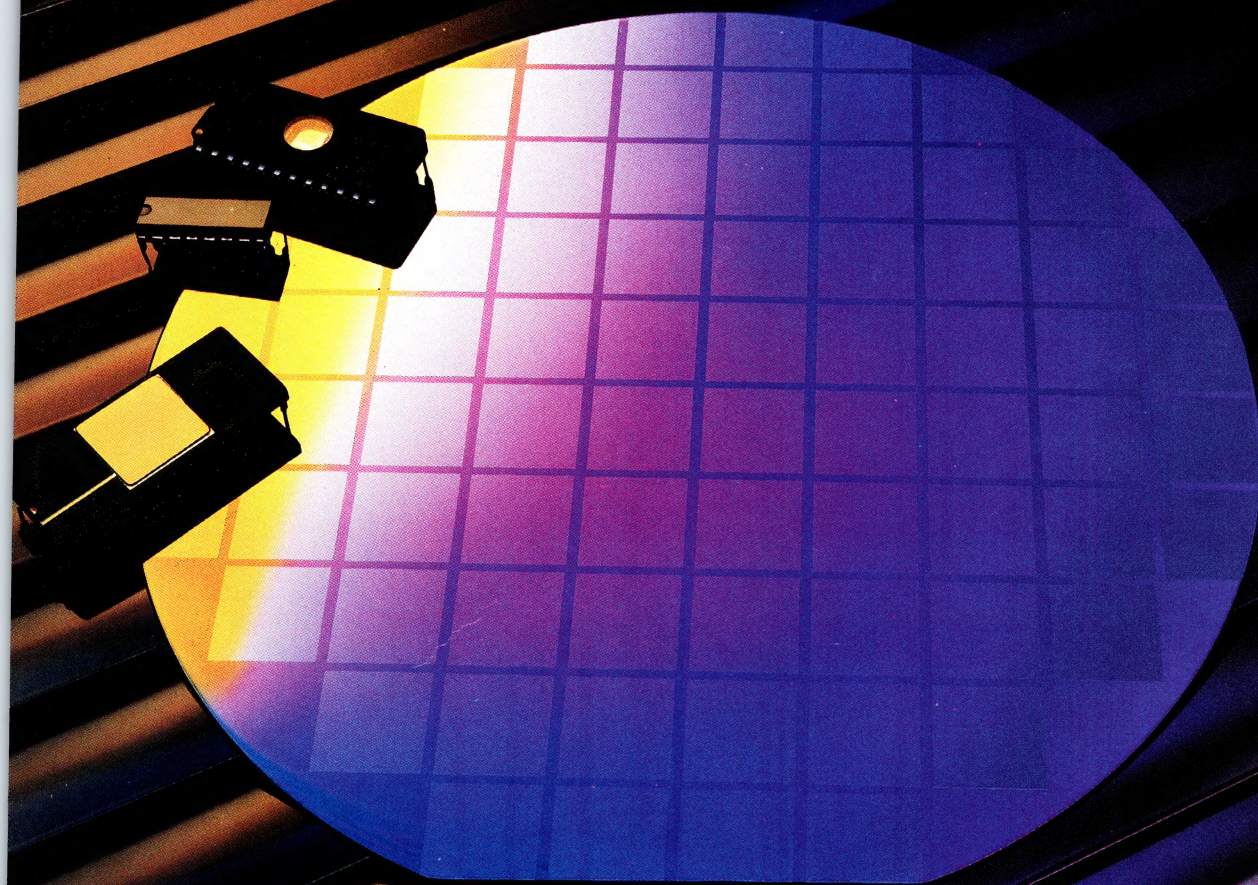
The race in the fifth-generation-computer derby is heating up. The prize is a vast market for big, fast, intelligent machines, as well as the giant steps in peripheral technologies, particularly semiconductor processing, that must be made along the way. The handicappers, following their form charts, have made favorites of the U.S. and Japan.

But the wise bettor might want to put some of his cash on a few long shots, such as West Germany or Great Britain, both of whom are conceding nothing to the front runners. After reading the story on p. 30, one might even be inclined to wager an additional shilling or two

on the Britons. The researchers there now have a mandate from the people in charge of the UK's fifth-generation work to use native technology in coming up with a semiconductor process that can put 1 million devices with 1- μ m features on a chip—and to do it within five years. Some \$81 million is being poured into the work, which is focusing on five processes and is being done by a small army of industrial and academic research labs.

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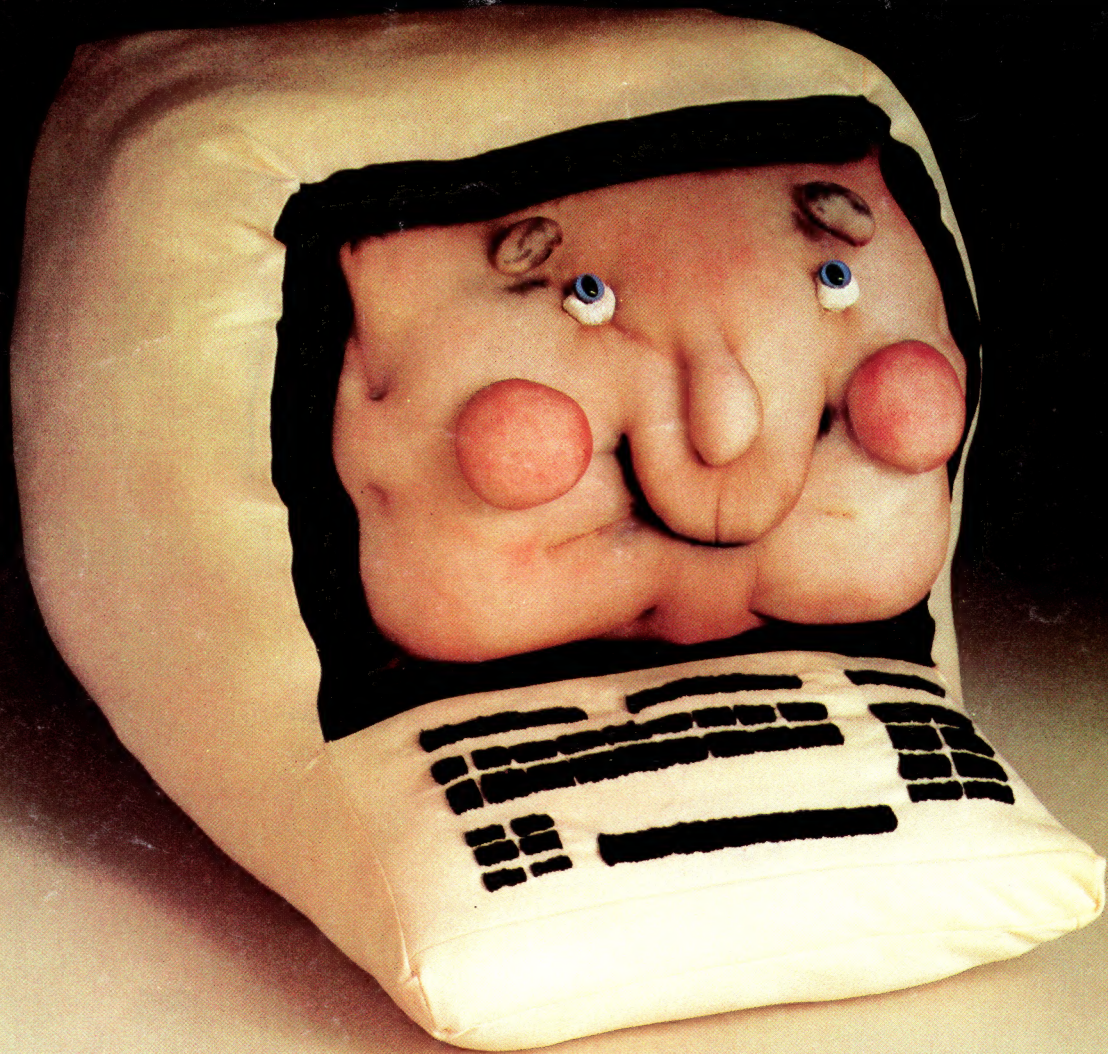
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